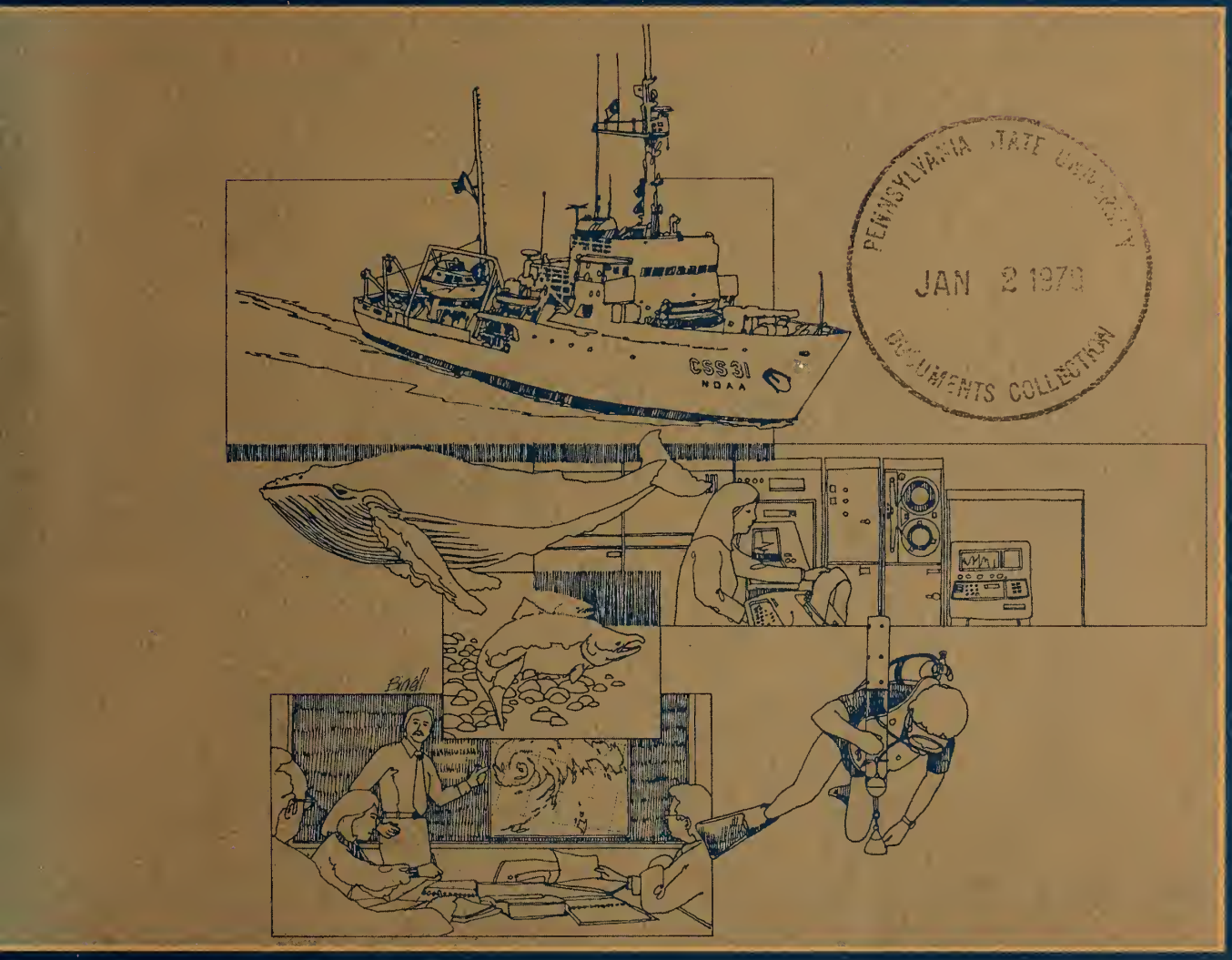
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November 1978

Final

Supplemental Environmental Impact Statement
For the Proposed NOAA Western Regional Center Development



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1 Introduction

INTRODUCTION

This document is a supplement to the "Final Environmental Impact Statement for the proposed NOAA Western Regional Center Development, Sand Point, Seattle, Washington" (FEIS), which was issued January 30, 1976. The proposed action considered in this supplement is the development of a Western Regional Center for NOAA at Sand Point.

The decision to prepare a supplement to the FEIS followed a court decision finding the NOAA FEIS deficient. On December 29, 1977, Save Lake Washington (a non-profit corporation) and named individuals filed a lawsuit alleging that NOAA had violated several federal laws, including the National Environmental Policy Act; eight substantive issues were raised in the suit. On February 24, 1978, the United States District Court for the Western District of Washington granted a preliminary injunction against further action by NOAA to establish the proposed docking structures at the Sand Point facility. The order granting the injunction was based on a decision by the Court that a trial on the merits would find that the plaintiffs were correct in two of their claims: 1) that the FEIS did not adequately discuss navigational risks, and 2) that alternative sites, including split-site alternatives (which might avoid some or all of the adverse environmental impacts of the project at Sand Point) were not adequately evaluated.

The purpose of this supplemental EIS is to evaluate navigational risk and to analyze several alternative sites in more detail. The alternatives considered include three "split-site" alternatives where

ships and their support activity requiring access to the water would be located at one site, and those activities not directly related to ship activity would be located at Sand Point. Six alternative sites for a consolidated facility are also analyzed.

Concurrent with the development of this supplemental statement, NOAA has prepared two management documents that reconsider the previous decision to consolidate at Sand Point. One report analyzes and compares administrative effectiveness of consolidated development and split or dispersed development (NOAA, 1978a).The second report discusses and rates the alternative sites in terms of operational factors (NOAA, 1978b). These reports conclude that consolidation is preferred for achieving optimal effectiveness and program efficiency and that such consolidation should take place at Sand Point. Therefore, consolidation of NOAA activities at Sand Point continues to be the proposed action. The final NOAA management decision for development of a Western Regional Center will be a result of a balanced decision-making process that will include integrated consideration of the following factors: environmental impact, navigational risk, administrative effectiveness, site characteristics, ship activities, economics, accomplishment of agency mission, and public comment.

Development of a Western Regional Center at Sand Point, the proposed action, has been discussed in detail in the FEIS (NOAA, 1976). Similiarly, the no-action alternative is considered in that document. To facilitate comparison of the alternative sites with Sand Point, an analysis of existing environment and expected impacts of development at Sand Point is included in this supplement.

This chapter first provides a brief description of the proposed regional center and delineates its purpose. Next, the generation and screening of alternative sites is discussed. In Chapter 2 the present environment at each site is described and each of the alternatives is evaluated with respect to impacts that would be likely from development of the facility at that site, and measures that could be taken to reduce or eliminate these impacts. Navigational risk is one of the environmental components examined, and is discussed in more detail in Appendix A. In Chapter 3, environmental impacts at each site are compared and tradeoffs are discussed. A brief discussion of the no-action alternative is included. Chapter 4 provides a brief summary of the EIS.

DESCRIPTION OF THE PROPOSED ACTION

The nature of the facility that NOAA proposes to build is described in the FEIS; however, a brief summary of this information may be helpful to the reader. NOAA seeks to bring together in one location the more than 14 activities now scattered throughout Seattle. Management studies conducted by NOAA indicate that consolidation would increase the efficiency of NOAA operations (NOAA, 1978a). Activities of the groups to be located at the proposed regional center include weather forecasting, marine survey work, fisheries management, research dealing with the marine environment and related disciplines. A more complete description of the mission and operations of NOAA components in the Seattle area is provided as Part 1 of the FEIS (NOAA, 1976). A description of present activities at Lake Union is included as Appendix H.

The Western Regional Center would be the first such center in the

United States and would have jurisdiction over NOAA activities in the western United States and the Pacific Ocean. It would provide about 550,000 square feet (sf) of building space, 300,000 sf of outdoor work space and mooring space for twelve fishery and oceanographic vessels. These facilities would accommodate approximately 1850 employees in 1982 increasing to 2300 (including 400 students and 825 ship-based personnel) as the ultimate projected population. The facility would attract visitors; NOAA encourages general public interest in its activities and plans to provide visitor facilities as part of its Western Regional Center. The presence of the facility in a populated area offers the public an opportunity to better understand NOAA's missions, and periodic use of some NOAA facilities. The size of the site would determine whether high-rise or low scattered buildings are constructed. Landscaping to increase the visual amenity of the site and to block off-site views of parking lots and the like would depend on the overall design. Plants that blend with existing native vegetation and are consistent with the surrounding area would be used.

The piers must be located in 30-foot deep waters to avoid disturbance of the water bottom by ships up to a 19 foot draft. The planned mooring space could accommodate twelve ships including the ten Seattle-based ships presently in the NOAA fleet. All twelve vessels would rarely be in port simultaneously except between November and February; during other months, typically no more than two or three ships would be in port at one time. Transits by NOAA ships through the Lake Washington Ship Canal ranged from 69 to 82 per year between 1975 and 1977; ship traffic to and from a new facility is expected to generate no more than 120 ship transits per year. Routine maintenance on vessels is carried out at pierside; major repair operations are carried out at commercial shipyards (Appendix H).

PURPOSE OF THE PROJECT

The purpose of the proposed project is to consolidate the major organizational components of the National Oceanic and Atmospheric Administration (NOAA) now located in the Pacific Northwest. NOAA activities in and around Seattle are presently conducted at eight separate locations, seven of which are leased. Not only are NOAA organizational components separated from one another, but, in some cases, operational elements of the same component are not housed with other elements of that component. Such physical separation restricts optimal program coordination and control. In addition, most if not all facilities are inadequate in terms of their ability to accommodate NOAA's current activities and planned program expansion. Construction of a consolidated facility would bring operational elements and major components together and would solve the space problem (NOAA, 1978a). Expected benefits include:

- Reduction of duplicative administrative services, personnel travel and vehicle use.
- Modern, efficient space designed to meet NOAA's special needs and capable of accommodating known program expansion.
- Improved working relationships within and between components in a favorable research environment.

- o Reduction in lease and rent expenditures.

- o Prevention of further fragmentation and the attendant costs.

POTENTIAL ALTERNATIVE SITES

Thirty-four alternative sites were identified; these sites included the alternatives discussed in the Final Environmental Impact Statement on the proposed NOAA Regional Center (FEIS) and a number of properties identified by a commercial real estate broker (Coldwell Banker), by the General Services Administration, by local jurisdictions, and by individuals in the Puget Sound area. Potential alternative sites other than the FEIS alternatives were sought because many of those sites, identified over three years earlier, were no longer available. The process through which these alternative sites were identified was as follows:

All alternative sites identified in the FEIS were included; these sites were Sand Point, Manchester, Lake Union, Duwamish, and Piers 90-91. The second step was to include all federally-owned properties that are currently being excessed or surplused in the Puget Sound region. This information (obtained from the Real Property Division of the General Services Administration, Region 10) identified Astoria (Tongue Point), Mukilteo (Split), and Issaquah. Since January, 1978, NOAA has received letters from various municipalities and private parties proposing that NOAA locate its facilities within their jurisdiction. The third step of identifying alternative sites was to include specific sites identified by these individuals. The fourth step was to perform a survey of sites currently available in the private sector that might meet NOAA requirements. This inventory survey was accomplished by Coldwell Banker Management Corporation under contract to NOAA.

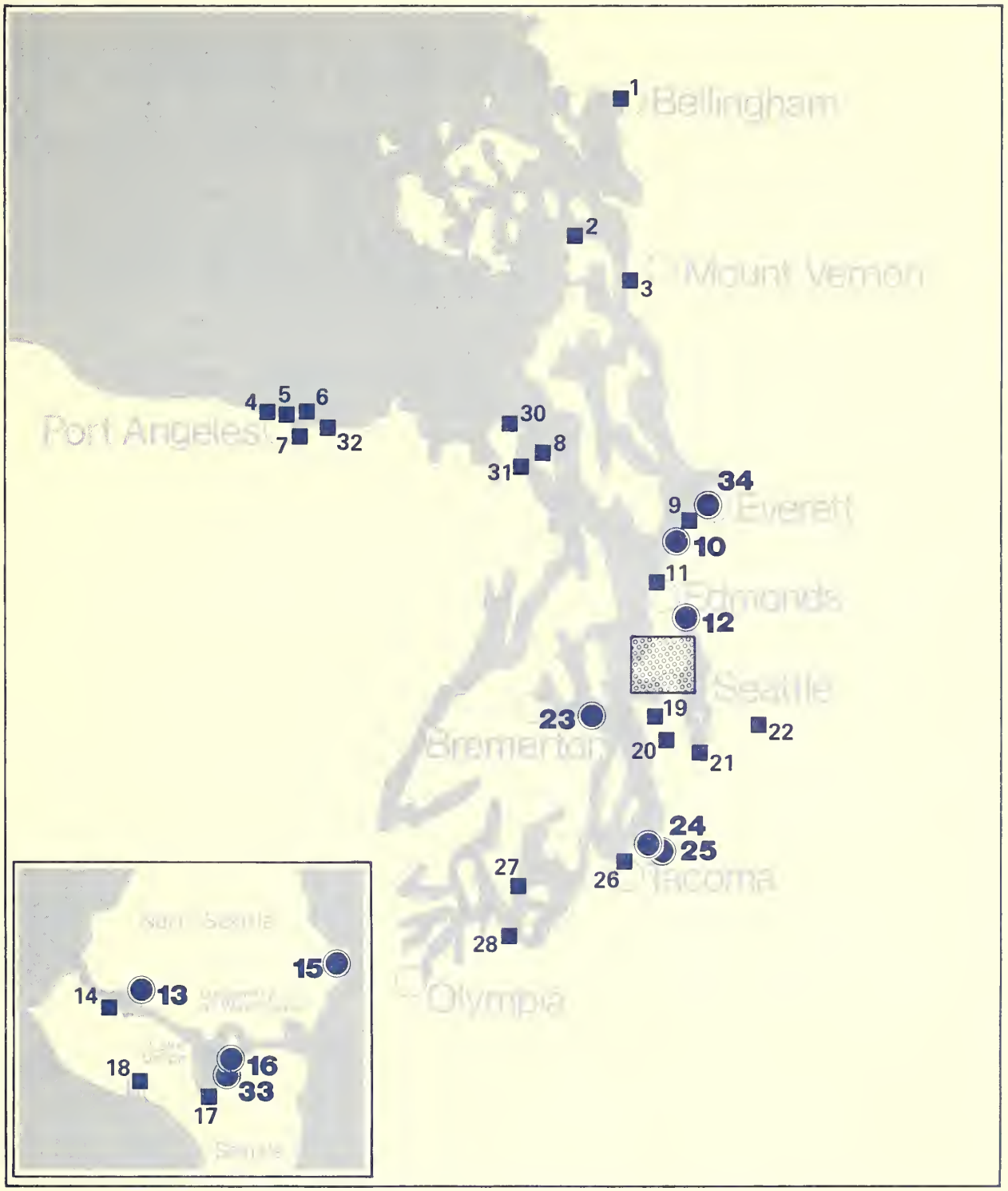
This approach identified the 34 sites shown in Figure 1-1. The size, zoning, present use, and waterfront footage for these sites are listed in Table 1-1, as are the land use and zoning of surrounding land parcels, availability of utilities, and accessibility. Some of these sites would be "split-sites"; that is, activities and support activities requiring access to water (ship-related activities) would be separated from those activities not directly related to ship activity.

SCREENING OF ALTERNATIVE SITES

To determine which of the potential sites would be feasible alternative sites, it was necessary to develop a list of physical and programmatic requirements against which to compare each site. Such a list was compiled by NOAA after considering the broad range of factors that are important in the overall development of a Regional Center. Selection of a location that could not satisfy each of these requirements would prevent development of an effective center (NOAA, 1978a, b).

These criteria, referred to as "program criteria", are listed in Table 1-2. Two sets of criteria are included: criteria for a single consolidated site and criteria for a separate waterfront site (to be developed in conjunction with development of shore facilities at Sand Point).

The physical space requirements (building space, moorage space, outdoor work area, and parking) were identified in the recently completed



Legend
- Sites Selected for Environmental Analysis
- Potential Alternative Sites (Numbers refer to Table 1-1)

Note: Site No. 29 (Potential) located at Astoria, Oregon

Scale in Miles

Figure 1-1

Sites Considered for NOAA Regional Center

	SITE	ACREAGE	WATERFRONT FOOTAGE	USE	ZONING[1]	SURROUNDING USE	SURROUNDING ZONING[2]	SHORELINE DESIGNATION[3]	UTILITIES[4]	INGRESS/EGRESS[5]	OWNERSHIP[6]
1	Bellingham (Split)	10	1,000	Undeveloped	Heavy Manufacuring	Industrial	Heavy Mfg.	Urban	Available	County Road	2
		25 (inland)	N/A	Undeveloped	Select Light Manufacturing	Bellingham International Airport	Select Light Mfg.	N/A (inland site)	Available	Airport Entrance Road	
2	Anacortes	30	2,000	Former Scott Paper Co. Mill	Industrial	Industrial	Industrial	Industrial	Available	'Q' Avenue, 14th-20th Streets	3
3	La Conner	157	(meets criterion)	Swinomish Tribal Port and Industrial Park	Under jurisdiction of Swinomish Indian Tribal Community	Undeveloped	Under jurisdiction of Swinomish Indian Tribal Community	Under jurisdiction of Swinomish Indian Tribal Community	Available	Hwy. 20 to Anacortes is adjacent to site connecting with I-5 eight miles eastward	3
4	West Port Angeles	100	400	Undeveloped & Gravel Mining	N/A, No Zoning	Undeveloped	N/A, No Zoning	Rural	Available	Yes	3
5	Port Angeles Airport (Split)	80 (waterfront)		North Industrial Site, Open Space, Commercial Industrial, Logging	M-1, Industrial	Airport Park, Public Public Facilities	M-1, Industrial	Urban	Available	16th & 18th Streets, Lauridson Blvd., Airport Road	2
		several hundred (inland)		Port Angeles Air Industrial Park	M-1, Industrial	Across 19th Street - Residential	RS-9, Single Family Residential	N/A	Available		
6	Port Angeles-Ediz Hook	(85)	(meets criterion)	Coast Guard Air Station (part)	N/A (Federal lands)	Coast Guard Air Station	M-2, Industrial	Urban	Available	Yes	1
7	Port Angeles-Francis St.	30	(meets criterion)	Fillable Tidelands	M-2, Industrial	Industrial	M-2, Industrial	Urban	Available	Poor Traffic Access	3
8	Indian Island	(2100)	()3,000)	Keyport Naval Installation (part)	N/A (Federal lands)	Residential-Forestry	Not Zoned	N/A	Available	Yes (Road to South End)	1
9	Mulkiteo (Split)	10	1,092	Fillable Tidelands	Single Family Residential	Mukilteo P.O.L. Facility	Residential/Commercial	No desig. along shoreline; offshore Conservancy		No	1
		24.82	N/A	Paine Field Annex (2 Parcels)	General Commercial Light Industrial	Paine Field	General Commercial Light Industrial	N/A	Available	Beverly Park - Edmonds Road	3
10	South Mulkiteo (2 Parcels)	40	2,600	Undeveloped	H-1, Industrial	Residential & Industrial	RR & H-1, Rural Residential & Industrial	Conservancy	Available	96th Street S.W. Beach Drive	3
		50-60	900	Undeveloped	RR, Rural Residential	Residential & Industrial	RR & H-1, Rural Residential & Industrial	Conservancy	Available	108th Street S.W. 116th Street S.W.	

FOOTNOTES

[1]Zoning designation under applicable county or city zoning ordinances.

[2]Zoning designation of lands immediately adjacent to site.

[3]Environmental designation of adjacent shoreline as designated in shoreline master program of applicable county or city government.

[4]Availability of water and sewer hookups adjacent to sites.

[5]Streets providing access to the site.

[6]Ownership - 1. Federal
2. Non-federal public lands
3. Private

Table 1-1
Site Characteristics

	SITE	ACREAGE	WATERFRONT FOOTAGE	USE	ZONING[1]	SURROUNDING USE	SURROUNDING ZONING[2]	SHORELINE DESIGNATION[3]	UTILITIES[4]	INGRESS/EGRESS[5]	OWNERSHIP[6]
11	Edmonds	3.3	800	Undeveloped	Residential	Burlington Northern RR on East, North & South, Undeveloped Private Land	Residential	No desig. along shoreline; deepwater-conservancy	All utilities would have to be brought in	No Access; located off of Puget Sound Drive, near Water St. and Ocean Ave.	3
12	Kenmore	36	500	Pioneer Towing Co.	Industrial	Industrial Uses	Industrial/Commercial	Urban	Available	68th Avenue N.E., N.E. 175th Street	3
13	Salmon Bay	12	2,000	Seattle Cedar Lumber Mfg. Co.	I-G, General Industrial Mfg. and I-H, Heavy Industrial Mfg.	Industrial Uses	General Industrial Mfg., Heavy Industrial Mfg.	Urban Development	Available	Shilshole Avenue N.W.	3
14	Salmon Bay/ Coast Guard	/+2.5	/not adequate ∿ 50	Coast Guard Support Center/Fort Lawton Remote Transmitter Site	RS 7200, Single Family Residential, Medium Density	Residential	RS 7200, Single Family Residential Medium Density	Urban Development	Available	Valley Street	1
15	Sand Point	114	1,300	Former Naval Air Station	RS 7200, Single Family Residential, Medium Density	Naval Support Activity, City Park	Single Family Residential	Conservancy Management	Available	Sand Point Way	1
16	Lake Union (PMC)	2.53	(meets criterion)	Pacific Marine Center	Manufacturing (M)	Manufacturing and General Commercial	Manufacturing and General Commercial	Urban Stable	Available	Fairview Avenue E.	1
17	Lake Union (NRC)	∿3		Naval Reserve Center	Manufacturing (M)	Manufacturing and Commercial	Manufacturing and General Commercial	Urban Stable	Available	Valley Street	1
18	Piers 90-91		(meets criterion)	Former Naval Supply Center & Potential Deep Water Port	I-G, General Industrial	Industrial	I-G, Industrial	Urban Stable/ Conservancy Management	Available	W. Halladay Street Lawton Avenue	2
19	North Duwamish River		(not adequate, dredging required)	Federal Center South	I-H, Heavy Industrial	Industrial	I-G, Industrial	Urban Development	Available	West Marginal Way S.	1
20	South Duwamish River	24	475	Former South Park Courts (State Housing Authority)	Residential	Residential	Residential	Urban	Available	14th Avenue S.	3
21	Renton	20	1,350	G. H. Baxter & Co.	Industrial	Residential	Residential Medium Density	Urban	Available	E. Mercer Way	3
22	Issaquah	7.6	N/A	Seattle Defense Area Housing (Single Family Residences)	Single Family Residential	Residential	Single Family Residential	N/A (inland)	Available	S.E. 46th Street 164th Avenue S.E.	1

FOOTNOTES

[1] Zoning designation under applicable county or city zoning ordinances.

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[3] Environmental designation of adjacent shoreline as designated in shoreline master program of applicable county or city government.

[4] Availability of water and sewer hookups adjacent to sites.

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[6] Ownership - 1. Federal
2. Non-federal public lands
3. Private

Table 1-1 (con.)
Site Characteristics

	SITE	ACREAGE	WATERFRONT FOOTAGE	USE	ZONING[1]	SURROUNDING USE	SURROUNDING ZONING[2]	SHORELINE DESIGNATION[3]	UTILITIES[4]	INGRESS/EGRESS[5]	OWNERSHIP[6]
23	Manchester	(100)	(meets criterion)	Undeveloped, Former U.S. Naval Reserve	Public Use	State Park (Undeveloped), EPA Laboratory, and Private Land	Rural	N/A	All utilities would have to be brought in	Beach Drive	2
		22.5		National Marine Fisheries Lab				(Surrounding areas 'Conservancy')			
24	North Hylebos	69	3,180	Fillable Tidelands	M-2, Heavy Industrial	Industrial	M-2, Heavy Industrial	Urban	Available	Marine View Drive	2
25	South Hylebos	29	1,150	Industrial	M-2, Heavy Industrial	Industrial	M-2, Heavy Industrial	Urban	Available	Taylor Way	3
26	City Waterway	17	600-800	St. Regis Door Factory & Plywood Mill	M-2, Heavy Industrial	Industrial	M-2, Heavy Industrial	Urban	Available	'D' Street, E. 15th Street	3
27	Longbranch	100	2,640		Suburban Residential		Suburban Residential	Rural		Yes	3
28	Hawks Prairie	1200	3,000	Undeveloped	Industrial Park & Transportation Corridor	Undeveloped	Suburban Rural	Rural (Changed from Industrial)	Available	Marvin Rd.	3
29	Astoria	175	(meets criterion)	Tongue Point Job Corps Center					Available	Yes	1
30	Fort Worden	339	(meets criterion)	State Parks & Recreation Commission	N/A (State Park)	Residential/Coast Guard Radar Station	Residential	Natural Environment		Yes	2
31	Port Townsend			Forestry/Green Belt	Not Zoned	Forestry	Not Zoned	Suburban		Yes	3
32	East Port Angeles (Green Point)				R-2, Suburban Residential		R-2, Suburban Residential	Conservancy		Gasman Road	3
33	Lake Union (Private)	9	600	Dry Dock	M, Manufacturing	Pacific Marine Center	M, Manufacturing	Urban Stable	Available	Fairview Avenue E.	3
34	Everett	105	(meets criterion)	Industrial	M-1, Heavy Manufacturing	Industrial	M-1, Heavy Manufacturing	Urban	Available	21st Street, Norton Avenue	2

FOOTNOTES

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[4] Availability of water and sewer hookups adjacent to sites.

[5] Streets providing access to the site.

[6] Ownership - 1. Federal
2. Non-federal public lands
3. Private

Table 1-1 (con.)
Site Characteristics

TABLE 1-2

Program Criteria*

Criteria for Consolidated Site

Building Space:	Approximately 550,000 sq. ft. (gross).
Vessel Accessibility:	Site must be on waters navigable by all NOAA vessels with access to the Pacific Ocean.
Moorage Space:	Necessary space to accommodate 12 research and hydrographic vessels.
Compatible Land Use:	Development should be consistent with all legally applicable land use regulations and shoreline management plans.
Availability:	Developed or undeveloped site must be largely owned or available for acquisition by the government.
Outdoor Work Area:	300,000 sq. ft.
Parking:	1,050 spaces (automobile).
Range of Acreage:	30 to 120 with the lower number indicating a plan utilizing high-rise construction and the higher number indicating a plan having low level multiple buildings in a "campus like" setting.
Distance:	Site should be located within a 60-minute driving distance from the University of Washington and the National Marine Fisheries Service Facilities in Montlake, and primary NOAA user groups.

Criteria for Waterfront Portion of Split Site

Building Space:	A minimum of 40,000 sq. ft. (gross).
Vessel Accessibility:	Site must be on waters navigable by all NOAA vessels with access to the Pacific Ocean.
Moorage Space:	Necessary space to accommodate 12 research and hydrographic vessels.
Compatible Land Use:	Development should be consistent with all legally applicable land use regulations and shoreline management plans.
Availability:	Developed or undeveloped site must be largely owned or available for acquisition by the government.
Outdoor Work Area:	Approximately 35,000 sq. ft.
Parking:	175 spaces (automobile).
Acreage:	Minimum of approximately 3 acres.
Distance:	Must be located within a 30-minute driving distance of Sand Point.

*These criteria were identified as requirements by the project sponsor.

Concept Program of Facility Requirements (Naramore Bain Brady and Johanson, 1978). These requirements represent known space needs projected to 1982.

The availability criterion means that the site must be presently owned by the government or available for purchase, lease-purchase option, or lease. It specifically excludes acquisition by condemnation. (NOAA, 1978a, b).

The desired proximity to the University of Washington is based on the long standing working relationship that exists between NOAA and the University. Twenty one NOAA scientists currently hold affiliate positions with the University and routinely lecture various courses. NOAA scientists are also actively involved in various graduate study programs at the University of Washington. In return, the University holds sixteen major contracts that provide NOAA with research, computer, and technical services that could not be provided by other area institutions. There is almost daily interaction between NOAA personnel and the University Department of Atmospheric Sciences and Oceanography, the College of Fisheries, the Sea Grant Programs, and the Applied Physics Laboratory. On the average, 75 NOAA scientists make more than 80 visits to the University each week. NOAA scientists also make considerable use of the University's comprehensive technical libraries. To facilitate continuation of these relationships, the site should be located within a 60-minute driving distance from the University of Washington and the National Marine Fisheries service facilities in Montlake. (See also NOAA, 1978b). Borderline sites beyond this range will be considered only if they appear particularly well suited to NOAA needs.

NOAA Seattle elements primarily interact with user groups also located in Seattle, including a number of federal, city, and county agencies, public media, and industry and laboratory representatives in the fisheries field. Direct NOAA services include briefing television weathermen and groups of local fisherpersons, providing climatic data and a convenient sales office, and coordinating marketable fishery products. In return, NOAA receives valuable feedback on the quality and usefulness of the services. For these reasons, and to minimize energy consumption, cost, and loss of productive time, the proposed center should be within 60 minutes driving time of Seattle (NOAA, 1978b).

Many potential sites were eliminated during this screening process. Tables 1-3 and 1-4 summarize the screening process for consolidated and split site alternatives. Several sites were too small, including those in Renton, Edmonds, a site on City Waterway in Tacoma, the Coast Guard Salmon Bay site, and one of two sites on the Duwamish River. The second Duwamish River site, identified in the FEIS, is no longer available as it is now being used by the U.S. Army Corps of Engineers, Seattle District Office. Other FEIS alternative sites, Piers 90-91 in Seattle and Fort Worden, are also unavailable; Piers 90-91 have become part of the Port of Seattle, while Fort Worden is now a state park. Similarly, the Naval Reserve Center site on Lake Union and the Coast Guard Salmon-Bay site are not available. Most of the remaining sites were located more than sixty minutes from the University of Washington. Sites rejected as too distant include those near Longbranch, Port Angeles, East Port Angeles, West Port Angeles, Anacortes, Indian Island, Port Townsend, La Conner, Bellingham, and

TABLE 1-3

Summary of Screening Process - Consolidated Sites

	Site	Program Criteria: Vessel Access	Moorage Space	Compatible Land Use	Availability	Acreage	Distance
1.	Bellingham	Yes	Yes	Yes	Yes	Yes	No
2.	Anacortes	Yes	Yes	Yes	Yes	Yes	No
3.	La Conner	No	Yes	Yes	Yes	Yes	No
4.	West Port Angeles	Yes	Yes	Yes	Yes	Yes	No
5.	Port Angeles - (Air Port)	Yes	Yes	Yes	Yes	Yes	No
6.	Port Angeles - (Ediz Hook)	Yes	Yes	Yes	Questionable*	Yes	No
7.	Port Angeles - (Francis Street)	Yes	Yes	Yes	Yes	Yes	No
8.	Indian Island	Yes	Yes	Yes	Yes	Yes	No
9.	Mukilteo	Yes	Yes	Yes	Yes	No	Yes
10.	South Mukilteo	Yes	Yes	Yes**	Questionable*	Yes	Yes
11.	Edmonds	Yes	Yes	Yes	Questionable*	No	Yes
12.	Kenmore	Yes	Yes	Yes	Questionable*	Yes	Yes
13.	Salmon Bay (Private)	Yes	Border-line	Yes	Questionable* (lease only)	No	Yes
14.	Salmon Bay - (Coast Guard)	Yes	Yes	Yes	No	No	Yes
15.	Sand Point	Yes	Yes	Yes***	Yes	Yes	Yes
16.	Lake Union North (PMC)	Yes	Border-line	Yes	Yes	No	Yes
17.	Lake Union - (Naval Reserve Center)	Yes	Yes	Yes	No	Yes	Yes

TABLE 1-3 (CONTINUED)

Site	Program Criteria					
	Vessel Access	Moorage Space	Compatible Land Use	Availability	Acreage	Distance
18. Piers 90-91	Yes	Yes	Yes	No	Yes	Yes
19. North Duwamish River	Yes	Yes	Yes	No	Yes	Yes
20. South Duwamish River	No	Yes	Yes	Yes	No	Yes
21. Renton	Yes	Yes	Yes	Yes	No	Yes
22. Issaquah	No	No	No	Yes	Yes	Yes
23. Manchester	Yes	Yes	Yes	No	Yes	Borderline
24. North Hylebos	Yes	Yes	Yes	Yes	Yes	Yes
25. South Hylebos	Yes	Yes	Yes	Yes	Borderline	Yes
26. City Waterway	Yes	Yes	Yes	Yes	No	Yes
27. Longbranch	Yes	Yes	Yes	Yes	Yes	No
28. Hawks Prairie	Yes	Yes	Yes	Yes	Yes	No
29. Astoria, Oregon	Yes	Yes	Yes	Yes	Yes	No
30. Fort Worden	Yes	Yes	Yes	No	Yes	No
31. Port Townsend	Yes	Yes	Yes	Yes	Yes	No
32. East Port Angeles	Yes	Yes	Yes	Yes	Yes	No
33. Lake Union South (Private)	Yes	Yes	Yes	Yes	No	Yes
34. Port of Everett	Yes	Yes	Yes	Yes	Yes	Yes

* Conditions under which property would be available have not been fully determined.
** Would be compatible if proposed zoning changes are adopted.
*** Zoning is residential; however, current use is public.

TABLE 1-4

Summary of Screening Process - Split Sites

	Site	Vessel Access	Moorage Space	Compatible Land Use	Availability	Acreage	Distance
1.	Bellingham	Yes	Yes	Yes	Yes	Yes	No
2.	Anacortes	Yes	Yes	Yes	Yes	Yes	No
3.	La Conner	Yes	Yes	Yes	Yes	Yes	No
4.	West Port Angeles	Yes	Yes	Yes	Yes	Yes	No
5.	Port Angeles - (Air Port)	Yes	Yes	Yes	Yes	Yes	No
6.	Port Angeles - (Ediz Hook)	Yes	Yes	Yes	Questionable	Yes	No
7.	Port Angeles - (Francis Street)	Yes	Yes	Yes	Yes	Yes	No
8.	Indian Island	Yes	Yes	Yes	Yes	Yes	No
9.	Mukilteo	Yes	Yes	Yes	Yes	Yes	No
10.	South Mukilteo	Yes	Yes	Yes	Questionable	Yes	No
11.	Edmonds	Yes	Yes	Yes	Yes	No	No
12.	Kenmore*	Yes	Yes	Yes	Questionable	Yes	Yes
13.	Salmon Bay (Private)	Yes	Borderline	Yes	Questionable (lease only)	Yes	Yes
14.	Salmon Bay - (Coast Guard)	Yes	Yes	Yes	No	Borderline	Yes
15.	Sand Point	Yes	Yes	Yes	Yes	Yes	Yes
16.	Lake Union North (PMC)	Yes	Borderline	Yes	Yes	Borderline	Yes
17.	Lake Union - (Naval Reserve Center)	Yes	Yes	Yes	No	Yes	Yes

TABLE 1-4 (CONTINUED)

	Site	Vessel Access	Moorage Space	Compatible Land Use	Availability	Acreage	Distance
18.	Piers 90-91	Yes	Yes	Yes	No	Yes	Yes
19.	North Duwamish River	Yes	Yes	Yes	No	Yes	Yes
20.	South Duwamish River	No	No	Yes	Yes	Yes	No
21.	Renton	Yes	Yes	Yes	Yes	Yes	No
22.	Issaquah	No	No	Yes	Yes	No	No
23.	Manchester	Yes	Yes	Yes	Questionable	Yes	No
24.	North Hylebos	Yes	Yes	Yes	Yes	Yes	No
25.	South Hylebos	Yes	Yes	Yes	Yes	Yes	No
26.	City Waterway	Yes	Yes	Yes	Yes	Yes	No
27.	Longbranch	Yes	Yes	Yes	Yes	Yes	No
28.	Hawks Prairie	Yes	Yes	Yes	Yes	Yes	No
29.	Astoria, Oregon	Yes	Yes	Yes	Yes	Yes	No
30.	Fort Worden	Yes	Yes	Yes	No	Yes	No
31.	Port Townsend	Yes	Yes	Yes	Yes	Yes	No
32.	East Port Angeles	Yes	Yes	Yes	Yes	Yes	No
33.	Lake Union South (Private)	Yes	Yes	Yes	Yes	Border-line	Yes
34	Port of Everett	Yes	Yes	Yes	Yes	Yes	No

* Although the Kenmore site qualifies as a split-site as well as a consolidated site, it does not offer alternative ship moorage off Lake Washington as do the other split sites; therefore, it will be considered only as a consolidated site.

Astoria, Oregon. The site on the Swinomish Slough near La Conner is also navigationally unacceptable. One site, at Manchester, that was slightly further than sixty minutes from Seattle but appeared to meet other criteria was retained as a feasible alternative site.

The sites selected for environmental analysis are listed in Table 1-5. They include seven consolidated sites and three split-site alternatives. Under these split-site alternatives, all ship-related activity would be located at the location listed in Table 1-5 and all other activities would be located at Sand Point. The selected alternatives are shown in Figure 1-1.

TABLE 1-5

Alternative Sites Selected for Environmental Analysis

Consolidated Sites

- Everett
- South Mukilteo
- Kenmore
- Sand Point
- North Hylebos
- South Hylebos
- Manchester

Split Sites (location of waterfront facilities)

- Lake Union North (PMC)
- Lake Union South (Drydock)
- Salmon Bay

2
Environmental Analysis of Alternative Sites

This Chapter is divided geographically. Section 1 discusses environmental components that are constant to the Puget Sound region as a whole. The remaining sections are divided by specific sites. Within each site specific section are two subsections. The first deals with the existing environmental conditions, the second deals with the impacts expected if the proposed NOAA facility were located at that site and measures that could be taken to mitigate these impacts.

SECTION 1: OVERALL PUGET SOUND REGION

EXISTING ENVIRONMENT

Geology

All of the sites are located in the Puget Trough physiographic province that occupies the broad trough between the Olympic Range and the Cascade Range. A thick layer of unconsolidated materials deposited during the Pleistocene Epoch now fills the Puget Sound lowlands. The surficial geology of the area was most strongly influenced by the Puget Lobe of the Vashon glaciation. Glacial till, a mixture of clay, sand and gravel, and layers of sand, gravel and clay occur throughout much of the Puget Trough.

Earthquakes are a geologic risk common to the entire region. As indicated by Figure 2-1, which shows the location and magnitude of major earthquakes in the region since 1870, the Puget Sound area is seismically



Source: Pereira Assoc., 1977

Figure 2-1

Location and Magnitude of Major Earthquakes in the Puget Sound Region Since 1870

active. Seismic damage in the area is likely to be produced by strong ground motion, induced slope failure and the resulting landslides, and liquefaction of soils or sediments (which may occur on poorly compacted fill or in loose water-saturated sediments).

Climate

The area is characterized by mild temperatures, a pronounced though not sharply defined rainy season, and considerable cloudiness during the winter months. Temperatures generally range from the 30's to the 40's in the winter and from the mid to low 50's to the upper 70's in the summer. Precipitation is rather evenly distributed through the winter and early spring months; more than 75 percent of the yearly rainfall average falls from October 1 through March 1.

The southern end of the Puget Trough is open to southwest winds generated by storms moving in off the ocean; therefore, the prevalent wind direction for the eight month storm season is southwest. Winds are relatively light and generally northerly during the summer months.

Regional Air Quality

Air quality in the Puget Sound area is generally quite good. Localized industrial belts and concentrated population centers, however, do occasionally exceed federal, state and Puget Sound Air Pollution Control Agency (PSAPCA) ambient standards, and have been designated as nonattainment areas for suspended particulates, sulfur dioxide, carbon monoxide and photochemical oxidents. (These standards are listed in Appendix C.)

The PSAPCA and the Washington State Department of Ecology (DOE) operate an extensive air quality monitoring network in the Puget Sound area. Trends in air quality are best described in terms of total suspended particulates (TSP) since this pollutant has been the most extensively monitored. The long-term trend in the entire Puget Sound region appears to be moving gradually downward. Long-term data for carbon monoxide (CO), available from a few stations, indicate a downward trend in CO over the past five years.

Only total suspended particulates, sulfur dioxide (SO_2), and carbon monoxide levels are likely to be affected by the proposed project; hence, only these three pollutants will be addressed in the site specific discussions. Concentrations of CO should decrease due to automotive emission controls. TSP and SO_2 levels should also be decreased by 1983 since attainment of the standards by 1982 is required by federal law.

Puget Sound Water Quality

The water quality in Puget Sound, which borders many of the selected alternatives, is strongly influenced by its shape and by seasonal factors. Numerous rivers empty into the Sound; freshwater from these rivers tends to flow over the denser saline water, creating a salinity gradient near the mouths of major rivers. Therefore, surface salinities near such rivers drop quite low in late fall and early spring when river discharge is high. Movement of deeper, more saline oceanic water into Central Puget Sound is blocked by a shallow sill at Admiralty Inlet; from the Straits of Juan de Fuca however, deep water is drawn in over the sill into the central basin during monthly spring tides

(Cannon, 1978). A major intrusion into Central Puget Sound of deep oceanic waters, which are more saline and lower in dissolved oxygen content, occurs only during the period of coastal upwelling (early summer to October or November). Therefore, Puget Sound waters tend to have their highest salinity and lowest dissolved oxygen values during the late summer and early fall. Water temperatures vary with solar radiation. A 30 to 40 foot thick warmer surface layer develops during the summer. During winter months, the temperature of surface and deeper water is nearly the same. The nearshore water movement is a function of tides, winds, surface currents and deep currents. Movement of water along the shoreline follows the contours of the shoreline with the change in tides.

Terrestrial Biology

No endangered or threatened species are known to occur on any of the alternative sites.

Land Use

The local comprehensive land use plans for the shoreline areas are assumed to be consistent with the Shoreline Master Programs for those areas.

Navigational Risk

Navigational risks entering and within Puget Sound are minimal. (The information summarized here is taken from Appendix A, to which the reader is referred for a more detailed discussion.) Puget Sound in general offers sheltered berths and deep waters. Night and early morning fog, which generally breaks by midday, occurs frequently, particularly in the winter. The Coast Guard operated Vessel Traffic System that extends throughout Greater Puget Sound as far south as Tacoma reduces navigational risks in the region by providing designated traffic lanes, navigational tracking, and a central control center. The accident rate for Greater Puget Sound for freighters, which are the commercial vessel type most comparable to the NOAA ships, is 3.5/per 1000 port calls. Freighters accounted for only 18 percent of all vessel accidents in the waters of Greater Puget Sound.

Several features of NOAA vessels (See Appendix 4 of Appendix A) are important in the assessment of navigational risk. Because of their scientific mission, the NOAA ships are equipped with additional propulsion, steering and navigational aids not generally found on commercial vessels. Nonetheless, because of their size, NOAA vessels must have adequate maneuvering room. NOAA ships have experienced breakdown in the water; however, such breakdowns are to be expected with any vessel. None of these breakdowns resulted in accidents, most occurred in open water. The senior officers and chief crew on NOAA vessels are experienced and well-qualified. NOAA officers, who are reviewed annually for performance and advancement, tend to be more careful in their operations than civilian masters, who are not subject to such close scrutiny. Nonetheless, since NOAA skippers are rotated about every two years, NOAA ships are operated by skippers without extensive local experience. New skippers normally experience at least one indoctrination passage of the Lake Washington Ship Canal to ensure familiarity with these waters.

IMPACTS AND MITIGATIVE MEASURES

In this section, impacts and

mitigative measures applicable to all sites are discussed. Effects of construction and operation of a facility of the type proposed by NOAA would naturally vary among the sites since such impacts depend on the existing environmental conditions. Nonetheless, a number of probable impacts are common to all sites. These will be discussed prior to the analyses of specific sites. In addition socio-economic impacts of moving from present facilities are discussed in this section.

Climate

Development of the proposed project would have no impact on climate except minor local changes in wind direction regardless of which site is selected.

Air Quality

Development of the proposed facility at any of the sites would have similar temporary impacts. Earth-moving vehicles and other construction equipment would generate dust and gaseous exhaust emissions during the construction and landscaping. The amount of pollutants generated would be small and would not cause violations of any ambient air quality standards. If operations are relocated, emissions of air pollutants from the ships and employee automobiles would also be shifted to the new location, a change of minor regional significance. Ship emissions include sulfur dioxide and suspended particulates. Use of a lower sulfer fuel would reduce sulfur dioxide emissions. Particulate emissions could be reduced by restricting soot blowing on the SURVEYOR (the only NOAA steam vessel in operation) as much as possible in port. For a more detailed discussion of expected ship emissions, see Appendix C.

Water Quality and Aquatic Biology

Operational practices with potential water quality impacts include handling of sewage and bilge water, dockside repair, and storm runoff. These operations are described in more detail in Appendix H. None is likely to produce significant impacts. Adverse dredging impacts are likely to be minimal and short-term.

When NOAA ships are transitting in the Seattle area, ship-generated sewage is stored in holding tanks. At dock, the sewage is pumped ashore into the city sewage system. Bilge water is handled in the same manner. Thus, there are no water quality impacts from ship-generated sewage or bilgewater. Such practices will continue at any of the sites chosen.

Routine dockside repainting of ships is not expected to have a significant impact upon either water quality or biota. Most paint chipping and repainting is done on the deck; therefore, most of the paint chips are swept up and disposed of as solid waste. Occasionally, badly weathered sections of the upper hull are scraped and most of the paint chips are lost in the water; however, this paint has a relatively inert vinyl base that is nontoxic to aquatic life. The presence of relatively small quantities of such paint chips in the sediments of the berthing area would not significantly affect benthic life. Major hull repainting and other major repairs are done at commercial shipyards.

All structural piers installed at any of the sites will be concrete, thus avoiding the possibility of

toxic effects to local aquatic organisms that might occur if standard wood pilings impregnated with preservatives were used.

Runoff from the ship maintenance and staging area is likely to contain high levels of suspended solids and oil and grease. Such runoff would be passed through a properly designed oil and grease separator prior to release. Such treatment, with sufficient settling time for solids removal, would minimize the water quality impacts.

If dredging is required at a site where water quality is sensitive, a two-phase monitoring program will be carried out to ensure that water quality conditions adjacent to the dredging operations are compatible with survival of fish. Phase one consists of 96-hour bioassays using coho fingerlings and various concentrations of the sediment and water. Such testing has already been carried out with water from Lake Washington and sediment from Sand Point; these tests showed that even high levels of suspended sediment had little effect on fish survival. During dredging, water quality would be monitored daily at a series of sites around the silt curtain (a physical barrier that would surround the site during dredging and block movement of sediment), dissolved oxygen levels, pH, temperature, and turbidity would be compared to criteria established in phase one. Dredging would also result in elevated levels of heavy metals where high levels are present in the sediment. Most of the heavy metals are tightly bound to the clay and silt fraction of the sediment are not biologically active; in addition, they are removed from the water as the sediment resettles. Use of a silt curtain to limit spreading of turbidity and the proposed monitoring program would minimize the direct aquatic impacts of dredging.

Dredging would also require disposal of the dredge spoils. Land application would be used for Sand Point and for sites with highly contaminated sediment. Open water disposal which is less expensive, would probably be used at those sites where it was judged appropriate and permissible as per Corps of Engineer's public interest regulations. Potential adverse impacts associated with land disposal can be avoided by appropriate handling. Turbidity resulting from runoff of the dredge spoils can be minimized by use of mechanical dredges and by channelling runoff from the dredged material to a settling pond before returning it to the adjacent water. Odor problems, which are likely to occur during stabilization of sediments with a high organic content (over ten percent), can be mitigated by covering the dredge spoils with a layer of soil. If deep water disposal was used, benthic fauna at the disposal site would be buried; populations would probably be reestablished within a few years.

Oil spills are a potential hazard for any vessel. Although infrequent, small dockside spills are most common, disasterous spills are possible; however, NOAA has not been responsible for any major spill. A major fuel spill would cause a visible slick, fouling of boat hulls, and contamination of ducks, gulls, and other water birds. If the spill reached the shore, rocks and beaches would be fouled and many intertidal organisms would be killed. The water soluble fractions of the spilled oil would move down through the water column, where fish and other organisms would be exposed to their toxic effects.

The adverse impacts of an oil spill can be lessened by prompt and efficient spill containment and cleanup. Oil booms are deployed at

all times around all NOAA vessels in port. NOAA's oil spill contingency plan is discussed in Section III, Appendix A. The Seattle District of the U.S. Coast Guard (USCG), which has responsibility for directing or overseeing all spill cleanup in local waters, has cleanup equipment that would be used if NOAA could not immediately contain a spill. In addition, spill cleanup service is available 24 hours a day from private cleanup services.

Natural Resources

Construction of the proposed facility would consume fossil fuels (for equipment) and mineral and other resources used as construction materials. New buildings would be required to meet GSA energy consumption goals (GSA, 1975). As a result, once the facility is operational, consumption of natural resources would be considerably less than that of the present NOAA operations. No other impacts are expected except where noted in site-specific discussions.

Noise

Development of the proposed facility would result in increased noise levels during both construction and operation. The highly variable nature of construction noise makes it extremely annoying. Construction noise is of particular importance when it occurs in or near residential areas, recreational areas, schools, and hospitals. The most prevalent noise sources of construction sites are from equipment powered by internal combustion engines. Pumps, generators, and compressors are generally stationary sources which radiate fairly constant noise levels when operating. Mobile sources, however, radiate varying noise levels depending on operating conditions and loads. Pile drivers can generate peak noise levels of from 95 to 106 dBA at 50 feet. A summary of noise levels that radiate from different types of construction activities is shown in Appendix D. Noise levels in residential areas in excess of 60 dBA are considered an adverse impact, as they are above acceptable levels for such areas.

Operational noise sources include vessel operations, on-site activity and vehicular traffic. Noise levels for vessels are listed in the FEIS (NOAA, 1976).

The Department of Transportation (DOT) standards are used in this report to evaluate the noise impacts of traffic. Levels recommended by the EPA to ensure protection of the public's health and welfare will be used to evaluate impacts.

The Washington Environmental Noise Regulation (WAC 173-60, 1975) identifies noise receptors in terms of land use classifications termed an "Environmental Designation for Noise Abatement (EDNA)." These regulations provide an indication of levels that the State considers acceptable in given areas.

The noise levels expected at noise sensitive receptors (EDNA-Class A) during construction could be mitigated in the following ways:

- Installation and maintenance of effective mufflers on all internal combustion engine powered construction equipment.
- Careful scheduling of equipment to keep average noise levels low.

- o Turning off idling equipment not scheduled for immediate use.
- o Using vibrating type pile drivers rather than impact pile drivers.

These mitigating measures would decrease noise levels by at least 10 dBA (Table D-2), which should reduce possible community annoyance during construction.

Demography

If a regional center is established, facilities presently used by NOAA in Seattle will be vacated. The demographic impacts to Seattle would vary with the location of the center. If the center were in Seattle, there would be no impact. If it were within commuting distance of Seattle, loss of population (about 6000 persons) and employment (both direct and indirect, e.g., service-related) from Seattle would be gradual; impacts on the Seattle housing supply would be insignificant. If the center were elsewhere in the Puget Sound area, population and employment would be lost in Seattle but not to the area; the tight housing market in Seattle would be eased slightly.

Land Use

Moving NOAA activities from existing locations would have no land use impact in Seattle except that the Lake Union PMC site would become available for industrial use.

Economic Forces

Establishing a NOAA regional center would vacate facilities presently used by NOAA in Seattle. This would not place additional properties on the tax rolls since NOAA presently leases from private landholders who pay taxes. The PMC location would become available to industry. Office space would be made available to other users; the continuing construction of new office space in Seattle indicates that a demand does exist. If the center were located outside Seattle, the diversity of that city's economic base would be slightly reduced, and jobs created by the multiplier effect in service industries would be lost.

SECTION 2: EVERETT

EXISTING ENVIRONMENT

Geology and Landforms

Much of the proposed Everett site (See Figure 2-2) is underwater; the remainder is level fill approximately 10 to 12 feet above water level. The site is bounded on the west, south, and east by water, and on the north by additional fill land. To the east lies the City of Everett, rising to elevations of 100 to 160 feet. Residential areas lying across Port Gardner south of the site are on steeper slopes, and rise to elevations of approximately 400 feet.

The only geologic hazard identified at this site is the regional seismicity. Of the specific hazards discussed under "regional geology," only ground failure due to liquifaction and strong ground shaking are probably risks at Everett. The



Legend
- ◉ Sediment Sample Sites
- ◎ STORET Water Quality Stations

Soundings in Feet

Note:
PSS006 and PSS005 off of map to the south

500 0 1000
Scale in Feet

Figure 2-2
Everett Site - Existing Conditions

actual susceptibility of the site to liquefaction would depend on the type of fill used.

Soils and Erosion

This site consists of man-made land, built by filling with debris and dredged material. Erosion potential of the land surface is low because it is flat; however, appropriate maintenance of the bulkheads is needed to prevent undercutting by the surrounding water.

Climate

The climate at this site differs from the regional climate with respect to winds and precipitation. The portion of Puget Sound near Everett experiences more frequent northerly winds than the rest of the Puget Sound region. In addition, winds from the southeast and northwest are more frequent than farther south in Puget Sound. Winds measured at the Medical-Dental Building in Everett also exhibit the predominant southeast wind direction. The steep bank near the project site probably causes some channeling of wind along the bank, but in general, the winds blow predominantly from the city toward the site. Light and variable winds occur only 4 percent of the time at the Medical-Dental Building. Because winds from the north and south often converge near Everett, precipitation is heavier and cloudy weather is more frequent.

Air Quality

The regional air quality discussion is applicable to the Everett vicinity. Except for sulfur dioxide levels, air quality in the local Everett area is generally better than that in most portions of the Puget Sound region. Existing carbon monoxide background is estimated at 2 ppm, based on the proximity of major sources of this pollutant. All total suspended particulate values are below applicable standards. Sulfur dioxide concentrations at the Medical-Dental Building, which is close to the site, were exceeded on a number of occasions during 1976 and 1977: the one hour standard (.25 ppm) was exceeded on 10 occasions in 1976 and 17 occasions in 1977; the 24-hour standard (.10 ppm) was exceeded once in 1977.

Water Quality and Aquatic Biology

Water and sediment quality near the Everett site are poor because of industrial activity in the area and poor water circulation. As a result, the area is not biologically productive. Extensive wood products industries, large areas of log rafting, and a discharge to the Waterway of about 45 million gallons per day (mgd) from a pulp and paper mill have caused a significant local deterioration of water quality. The Washington State Department of Ecology has assigned a Water Quality Classification of Class B to its waters (see Table B-1).

The East Waterway, where the site is located, is dredged to a depth varying from 30 and 40 feet below mean lower low water (MLLW). The present shoreline, which is entirely bulkhead or rip rap, drops off steeply. Tidal range is 7.4 feet. The circulation in the harbor area west of the Waterway is good; however, circulation within the enclosed East Waterway is restricted.

Water quality data for six sites

in or near the East Waterway (see Table B-2) shows a progressive decline in water quality as one proceeds into the Waterway. Minimum dissolved oxygen levels decrease and coliform levels increase. (It should be noted that the data is seven years old and that improvements in local water quality are expected as the pulp and paper mill converts to required secondary treatment.)

The Army Corps of Engineers has tested the sediments at five locations within the East Waterway at the points shown in Figure 2-2. (See Table B-3). Substantial quantities of wood bark and splinters were present at three of these sites, and very high levels of chemical oxygen demand and volatile solids were found. Substantial concentrations of soil and grease and sulfide were also observed. Elutriate tests, however, showed only moderate releases of three heavy metals (zinc, nickel and copper).

The deep water depth and the poor water and sediment quality conditions indicate that the East Waterway is not a biologically productive area. Port Gardner as a whole is an excellent area for Dungeness crab, which are known to inhabit the lower channel west of the East Waterway. Ron Westley of the Washington State Shellfish Laboratory stated that the East Waterway might be visited by the crabs, which are highly mobile. The Waterway itself is not part of a major fish migration route; however, juvenile and adult salmonids from the Stillaguamish-Snohomish River systems pass through the area, as do a significant portion of Skagit River and southern Puget Sound salmon runs. Sport salmon fishing occurs in the area year round, and commercial fishing occurs in the vicinity from July through November.

Terrestrial Biology

The vegetation at the Everett site is typical of industrial fill sites in the Puget Sound area, consisting mainly of unmaintained species of grasses and weeds. The only animal species observed during a site visit were pigeons and gulls. The site is not locally or regionally significant as a habitat for terrestrial species. (See Appendix E for species lists.)

Natural Resources

No significant natural resources occur on this site.

Aesthetics

Most of the proposed site is underwater. Currently undeveloped, the site has been proposed for filling and industrial use. The site is surrounded by heavy industry and shipping activity. The Port area, which has been committed to industrial use for years, has the visual characteristics typically associated with such activity. From the site, views are of Everett Harbor and the Olympic Mountains beyond. Few homes view the Port of Everett.

Archaeological and Historic Resources

Although shoreline locales were favored by Indians in this area, and archaeological materials may have been present on the site, it has been so extensively disturbed by excavation and filling that no intact resources

are likely to be present. No such resources are known to exist on the site.

Noise

Noise levels in the area along the Everett shoreline are typical of levels in industrial and commercial areas. Dominant noise sources near the Everett site include a wood chip mill, truck traffic, and other light industrial activity. Daytime noise levels averaged from 59 to 61 dBA; noise data are given in Table D-1. The evening noise levels averaged 56 dBA. The peak evening noise level, 64 dBA, was caused by train traffic along the Burlington Northern Railroad line.

Demography

The population in Everett has been growing significantly since 1960 and is expected to continue to do so through 1985. The estimated 1977 population was 51,700. Population is expected to increase by 40 percent from the 1970 level to 88,000 people in 1985. Population growth slowed in the early 1970's because of the Boeing Company downturn and consequent layoffs at the Everett 747 plant. By the mid 1970's Boeing had recovered and was actively hiring at that plant.

Reflecting the current prosperity of Everett and Snohomish County, the housing availability is low even though new housing construction is at record levels. Most of the new housing is in south Snohomish County between Everett and Edmonds. Two large housing developments in this area are planned to accommodate over 32,000 new residents.

Economic Forces

The Everett area has a healthy manufacturing base of employment. The largest manufacturing industries are commercial airplane production and forest products. The industrial base is limited to two major industries; therefore, if either one has a difficult time, (as happened during the Boeing Company layoffs in the early 1970's), the Everett economy suffers. The present (April 1978) unemployment level in the Everett area is 5.5 percent, a level lower than the nationwide average of 6.0 percent.

Land Use

The Everett site, owned by the Port of Everett, is not being used at this time. Past users have included industrial shipping, and military activities. Much of the proposed site is underwater and would have to be bulkheaded and filled to be of use. Adjacent properties are used for heavy industrial purposes.

The City of Everett has zoning jurisdiction of the site and the shoreline. The site is zoned M-1, heavy manufacturing, which allows all uses except residential development. Everett has designated the shoreline "urban", a designation that allows dredging, and development of breakwaters, piers and ports.

Utilities and Energy

Water service is supplied at the site by the City of Everett, Department of Utilities. An existing 16 inch main on Norton Avenue feeds a 12 inch main on 21st Street that

extends west about 1170 feet. From that point west, the main is 8 inches. Static pressure on hydrants in this area is about 120 psi.

Sewer service is provided by the City of Everett. The closest public sewer service, an 18-inch diameter force main, is available at 21st and Norton. Sewer lift stations are located at 14th and Norton and 14th and Grand. A private force main runs parallel to to northern boundary and into the force main at 21st and Norton.

Electrical service is provided by Snohomish County Public Utility District No. 1. Power is presently available at the site.

Public Services

The area is served by the Everett Police Department, which is presently expanding to meet increased demands.

The City of Everett Fire Department provides fire protection services to locations within Everett. The Department has adequate capacity.

The Everett School District #2 serves Everett. The District is currently expanding; a middle school is being built in central Everett and an elementary school is being built in the south end. Facilities growth is keeping pace with population growth.

Transportation and Circulation

Access to the Everett site is available; roads near the site are not presently experiencing traffic problems. The site is served by Norton Avenue, a four lane street. The site would share an access road with Western Gear Company; an easement would probably be required. This private road is a wide two-lane facility with a traffic signal at its intersection with Norton Avenue. Freeway access is available via Pacific Avenue, which provides access through the downtown core, and via Alvenson Boulevard, a route that roughly follows the Snohomish River and provides relatively unimpaired access. Transit service, provided by Everett Transit Service, is available every half-hour at 21st and Norton Streets.

Navigational Risk

Navigational risks, discussed in depth in Appendix A, are summarized briefly here. The Everett site offers an open approach from Puget Sound, with unrestricted access through the dredged channel regardless of weather. Commercial shipping activity including log rafts, is present in the Port of Everett; the traffic density is relatively low. Small boating activity is present but not heavy near the commercial shipping activity. The Port is sheltered from the higher than average winds in the area. Vessels entering Everett from the south must cross the Mukilteo-Whidbey Island Ferry route. Tidal range is 7.4 feet, and currents are low.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

Construction of the regional center at this site would require filling an 80-acre area presently underwater. Otherwise, geology and landforms on the site would be unaffected.

Soils

The filling required for development of this site would add additional soils. During site preparation and construction, mounds of soil and rubble temporarily stored on the site would probably require containment berms. No long-term permanent impacts are expected on the soils of this site. Use of appropriate erosion control measures during construction would reduce on-site erosion.

Air Quality

Operation of the proposed consolidated facility would generate emissions from operation of ship engines, from movement out of port and from automobile traffic to and from the facility. Only sulfur dioxide emissions are likely to contribute to standard violations. Dispersion calculations (see Appendix C) indicate that sulfur dioxide emissions produced by ship emissions might heighten the existing problem with sulfur dioxide. Nonetheless, given the alignment of the site in relation to potential sources and to the monitoring station, it is unlikely that the project's contribution would occur when the station is experiencing its maximum recorded values. Total suspended particulate levels at the site are well below established standards and addition of the ship emissions would not cause any standard violations.

Carbon monoxide analyses were conducted for Norton Avenue just south of the proposed site access road. All concentrations are within applicable standards.

Little can be done to mitigate the problem with sulfur dioxide since it is an existing situation in the area; however, use of low sulfur oil would minimize the impact.

Water Quality and Aquatic Biology

The site includes 15 acres of filled land. As much as 80 acres would have to be filled to meet the requirements for the regional center. The approximate four million cubic yards of fill required would be obtained from maintenance dredging of the nearby Snohomish Channel, and possibly from other harbor expansions. Filling this area will halve the area of the East Waterway (see Figure 2-3), probably causing a reduction in water circulation and water quality, both of which are presently poor. Dissolved oxygen levels would probably decline, whereas levels of pollutants released in the area (color, turbidity, floatables, and so forth) would probably increase. These adverse water quality impacts could be mitigated by measures such as reduction of the existing industrial discharges into the Waterway or removal of contaminated sediments. Given the relatively low level of circulation in the inner portion of the Waterway, small dockside fuel and oil spills should be easy to contain. A boom system similar to the one presently used at the PMC site on Lake Union would be sufficient.

The filling would decrease the bottom area available as habitat for various benthic fauna. Although this impact would be relatively minor because the waterway does not offer high quality habitat, the precedent of filling 80 acres of saltwater habitat is of concern to the Washington State Department of Game. The habitat available to Dungeness crabs in the area would be



Figure 2-3
Everett Site - Impacts

slightly reduced by the filling of 25 to 30 acres of land south of the presently filled area. The reduction would not be regionally significant.

Terrestrial Biology

Construction and filling activities would remove all existing vegetation at the site. Ground animals and birds would be almost totally displaced during construction, but additional acreage and landscaping of the NOAA Center would increase the biological productivity of the site in the long run. Neither of these effects would be regionally significant.

Natural Resources

No impact is expected.

Aesthetics

Development of the NOAA facility at Everett would change the appearance of the site from one with some existing and future industrial buildings and equipment to one with a landscaped campus-like or commercial office building complex appearance.

Archaeological and Historical Resources

No impact is expected.

Noise

Noise impacts from both construction and normal operation at the Everett site would be insignificant because of the existing industrial activity near these sites (EDNA-Class C) and because of the absence of residential or other noise sensitive locations in the area. Noise criteria set by federal or state regulations would not be exceeded.

Demography

The present accelerated housing growth rate would continue longer than anticipated to accommodate NOAA personnel and their families. The overall net effect on the total number of new housing units built in the Seattle-Everett area would be minimal. The local employment level would probably not be greatly affected since many of NOAA's employees are specifically trained and educated for their positions. Any available positions would have to be filled according to usual civil service procedures.

Economic Forces

The proposed site is industrially zoned. If NOAA were to locate here, that industrial use would no longer exist. With limited industrially zoned properties available, a decision to take industrial property for this purpose should be evaluated carefully.

Because the proposed site is now publicly owned, no real estate tax revenue would be lost if NOAA were to locate on the site. As NOAA employees locate in the Snohomish County and Everett area, local revenues would increase as a result of increased real estate values, and increased sales and business occupation taxes. These benefits would have to be compared to the increased costs for supplying facilities such as roads and utilities to the facility, and to new housing areas to determine the benefit/cost.

NOAA employment in Everett would strengthen the economy by diversifying its employment base.

Land Use

The NOAA facility would be compatible with the Everett Shoreline Master Plan, zoning, and other surrounding uses. There would be some secondary impacts associated with relocating employees and their families in the surrounding area; this could be mitigated by advance planning for the new population and by the concentration of housing areas rather than allowing them to sprawl.

Utilities and Energy

Representatives of the Department of Utilities have indicated that to provide adequate fire flows to the Everett site the 8 inch main along 21st Street would have to be replaced with a 12 inch main.

Several modifications to the sewer system would be needed. A private force main would have to be installed from the site to the City's force main on Norton Avenue. The sewer system in this area is limited by the capacity of the two lift stations. The Sewer Superintendent of the City of Everett has indicated that although the current capacity of these lift stations could easily handle NOAA's average daily flows, they could not handle the estimated 530 gpm peak flow. To provide adequate service, the two lift stations would need to be equipped with larger pumps and motors.

Stormwater could be discharged directly into Puget Sound, providing that adequate controls for the prevention of pollutant discharge are constructed and maintained.

Representatives of the P.U.D. advise that NOAA's estimated demand could be met with available resources. No impacts are expected.

Public Services

The Everett Police Department foresees no problem in providing services to NOAA employees that might relocate in Everett. Population in the vicinity of the Port of Everett area is growing, and the Department is already expanding to meet increased demands.

The City of Everett Fire Department does not anticipate any problems in providing service to the NOAA center.

Everett School District #2 is presently in the process of expanding. Officials of the District estimate that facilities' growth is keeping pace with local population growth and no problems would be anticipated in absorbing growth from the NOAA center

Transportation and Circulation

Development of the NOAA facility at this site is not expected to have any adverse impact on traffic operations. The expected changes in traffic volumes are shown in Figure F-1a, Appendix F. The traffic signal system in Everett is now being converted to progressive operation to reduce delay time. NOAA peak hour traffic is not expected to coincide with existing major traffic generations; therefore, it will tend to smooth the traffic flow. The proposed marina development peak traffic hours are not expected to coincide with NOAA peak traffic.

Navigational Risk

Navigational risks would be low. Neither the ferry nor the commercial and recreational boating activity are likely to cause problems for NOAA vessels. Likewise, although maintenance dredging is required periodically in the Port of Everett, grounding is not likely to be a problem.

SECTION 3: SOUTH MUKILTEO

EXISTING ENVIRONMENT

Geology and Landforms

Like the region as a whole, the site is covered by unconsolidated glacial deposits. Stratified beds of silt and clay (Admiralty Clay) are exposed on the western half of the site; to the east the Admiralty Clay is overlain by a layer of fine sands (Esperance sands) with some silt beds (Newcomb, 1952).

Most of the site (See Figure 2-4) slopes toward the Sound. Elevations vary from about 420 to 460 feet along the shoreline, which is rip-rap stabilized railroad right-of-way. The steepest slopes occur along the western edge of the site, where steep 80 to 100 foot bluffs border the railroad. To the east the land levels out into a gently rolling terrain. The site is not visually separated from surrounding areas by topographic changes.

The major geologic hazards on this site are related to the steep slopes along the waterfront. Slope stability of the sand and clay deposits that underlie much of the site is poor (Snohomish Co. Planning Dept., 1977); hence slides are a potential problem for most of the site. Earth= quakes in the region could produce damaging landslides.

Soils and Erosion

Soils at the South Mukilteo site consist of Alderwood gravelly sandy loam and rough broken land (Anderson, et al, 1947). The gravelly sandy loam originates from glacial till, is 24 to 60 inches thick, and is underlain by compact till. The underlying consolidated material makes drainage poor and excavation difficult. Rough broken land is a general term for steep slopes where soil texture, stoniness, and depth varies.

Existing erosion problems are evident in the channelways along the north boundary and down the center of the site, and on the steeper slopes near the western site boundary. Evidence of stream erosion on adjacent terrain is minimal; erosion on these shallower slopes is minimized by the cohesive nature of the soils, the poorly defined drainage channels, the dense vegetation, and the gentler slope. The small scale erosion that is evident is caused by small undefined runoff channels and sheetwash flows.

Climate

The climate at the South Mukilteo site differs little from that of the region as a whole. The presence of steep bluffs causes winds to have a greater north-south directional component and may cause local variations in speed.

Air Quality

Air quality at the South Mukilteo site is probably quite high since the area is not densely populated and is not near a major source of air pollutants. Regional monitoring data indicate that levels of total suspended particulates and sulfur dioxide are well below standards. Carbon monoxide levels are also likely to be low.



Legend
● Sediment Sampling Sites
Soundings in feet

500 1000 1500
Scale in Feet

Figure 2-4

South Mukilteo Site - Existing Conditions

Water Quality and Aquatic Biology

The water quality of the South Mukilteo site is high, sediments are clean, and circulation is excellent. For these reasons, and because of the bottom profiles, the area supports many aquatic plants and animals.

Bottom profiles are shown in Figure 2-4. From the rock embankment along which the railroad line runs, the bottom slopes gently offshore. At low tide approximately 400 feet of sandy, rocky beach is exposed. The 18 foot contour is approximately 1100 feet offshore. Beyond this line, depth increases rapidly. There is considerable tidal circulation past the site. A peak ebbing surface current of one knot was measured in the shallow area offshore during a diver reconnaissance. The ebbing tide flows south (parallel to the shore) past the site, eventually rounding the south end of Whidbey Island.

The closest area for which data are available in the STORET water quality data bank is just off the town of Mukilteo. Table B-4 summarizes these data. Dissolved oxygen concentrations as low as 4.5 mg/l have been recorded and are probably a result of the inflow of deeper water from Possession Sound. Salinity values as low as 13 ppt have been measured and probably reflect the influence of the freshwater inflow of the Snohomish River, seven miles northeast of Mukilteo.

Two domestic sewage outfalls located in the vicinity of the site discharge secondary effluent. The Alderwood Water District operates a one million gallon per day (mgd) outfall located off Picnic Point, about two miles south of the site. The Olympus Terrace outfall, which serves the area just north of the site and discharges 0.5 mgd, is located about one mile north of the site.

The results of sediment analyses performed on two samples from the site (Table B-5) indicate a relatively clean sediment, as would be expected for a sandy bottom in an undisturbed location.

The area is biologically productive. Scattered geoduck clams occur offshore from the site (Westly, 1978). Scattered eelgrass beds exist in the vicinity. Some Dungeness crabs are found in the area; Picnic Point is a significant sports crabbing area. No hardshell clambeds are thought to exist near the site (Westly, 1978). Adult and juvenile salmon from the Stillaguamish-Snohomish River systems pass by the site, as do a significant portion of Skagit River and southern Puget Sound salmon runs. Sport salmon fishing occurs in the area year round, and commercial fishing occurs in the vicinity from July through November.

A bottom reconnaissance was conducted offshore of the site in water depths ranging from 10 feet to 35 feet. The bottom is composed entirely of sand; although rocks could be seen nearshore, more were observed in deeper waters. A sparse bed of eelgrass was seen along most of the bottom, but no kelp was present. Three Dungeness crabs, a few rock crabS, and a few sole were seen. Some geoducks were noted scattered along the bottom. Many sea pens were seen out to a depth of 20 feet, where their numbers dropped off. At least three species of starfish were common.

Terrestrial Biology

The South Mukilteo site is a moderately diverse community dominated

by red alder and big-leaf maple. Lesser amounts of Oregon ash, willow, Douglas fir, and vine maple also occur on the site. The dominant understory species is sword fern; other representative species occurring regularly in the understory are fringecup, bedstraw, dock, nettles, western springbeauty, blackberries and bracken fern. A wide diversity of animal species occur on the site. Birds using the rocky intertidal and offshore areas include gulls, western grebes, eared grebes, and great blue herons. On forested portions of the site, robins, crows, Steller's jays, bushtits, hummingbirds, rufous-sided towhees, song sparrows, and pileated woodpeckers have been observed; numerous other species would probably be seen with repeated observations. Mammal species likely to occur on the site include oppossums, raccoons, rabbits, moles, and shrews. Salamanders, toads, frogs, and garter snakes are also found here. The red alder-maple community commonly invades logged-off areas and presently occurs extensively in Snohomish County and in the overall Puget Sound region. See Appendix E for species lists.

Natural Resources

Natural resources of the South Mukilteo site are limited mainly to the land and soil. Although sand and gravel occur in the region, and clay has been mined within several miles north and south of the site, soils on the relatively level portions of the site probably do not contain significant amounts of these resources. The geologic units exposed along the bluff, Esperance sands and Admiralty clay, do contain significant amounts of sand and clay. The rough, broken soils are not suitable for agriculture but could be used for pasture or commercial timber production, although the relatively small size of the site would not make it efficient for these purposes.

Aesthetics

The South Mukilteo site is typical of undeveloped waterfront land along Puget Sound. The site is covered with trees and other natural green vegetation. Because the site slopes westward to Puget Sound, there are views from the entire site. Islands and the Olympic Mountains dominate the horizon. Below the bluff (and not visible from most of the site) are two railroad tracks that carry most of the north-south rail traffic serving the region. Noise from passing trains is heard at times. Communities border both sides of the site; these homes are not oriented toward the site.

Archeological and Historic Resources

Because this site is close to water, it is possible that archeological materials may be present on the site; however, no archeological or historic resources are known to exist on the site.

Noise

The South Mukilteo area is surrounded by rural and suburban areas, where noise levels typically average 35 to 50 dBA. The only significant noise sources in the area are the Paine Field Air Force Base (approximately 1.5 miles from the site), Washington State Route 99 (approximately 2.5 miles), and the main line of the Burlington-Northern Railroad, that runs along the western edge of

the site. Minor noise sources near the proposed site are Washington State Route 525 and scattered commercial buildings near this road.

The noise levels near the South Mukilteo site are typical of rural and suburban areas, with average daytime noise levels between 38 and 44 dBA and peak noise levels (L_{10}) between 43 and 50 dBA. The background noise source in this area is primarily from natural faunal activities (bird calls and the like). Although no trains passed during measurements, train traffic along the Burlington Northern Line at the base of the bluff would be expected to generate noise levels of approximately 80 dBA at 50 feet. Nighttime noise levels averaged 35 dBA, with peak levels of 36 to 37 dBA. This area is well within all daytime noise criteria for the State of Washington.

Demography

South Snohomish County is one of the fastest growing regions within Washington State. From 1960 to 1970, the population grew by 54 percent. This trend is expected to continue. Snohomish County had a 1977 population of 278,200 and by 1985, it is expected to have a population of 358,000. South Snohomish County will continue to grow because of its proximity to Seattle and the Boeing Company's current prosperity.

As a result of the present prosperity of Snohomish County the housing availability is low, even though new housing construction is at record levels. Most of the new housing is in south Snohomish County between Everett and Edmonds, the area where the South Mukilteo site is located. Two large housing developments in this area are planned to accommodate over 32,000 new residents.

Economic Forces

The economic forces affecting South Snohomish County are essentially the same as covered in the Everett discussion.

Land Use

The South Mukilteo site, presently owned by a private corporation, is undeveloped. New residential communities of expensive homes have been built along two adjoining sides of the property; while an industrial area is being developed east of the site. The residential areas are particularly attractive because of the view and their proximity to Puget Sound.

Snohomish County has jurisdiction over the site and the shoreline. The site is designated for suburban residential development by a 1969 Comprehensive Plan Amendment, but the proposed Possession Shores (land use) Master Plan, if approved, would supersede the zoning and designate the site for industrial use. Snohomish County expects that the property will be used for light industrial or research/scientific activity which, if the master plan is passed, would include an adjoining dock.

Snohomish County has designated the shoreline adjacent to the site as "urban". This designation allows dredging, construction of breakwaters, piers, and ports, and similar actions.

Utilities and Energy

Water service is provided by the Mukilteo Water District. No water service is presently available on the site; however, directly east of the site, a 16-inch water main extends

south along Kamiak Road to the District's southern boundary at 116th St. S.W. A second supply line, 12 inches in diameter, extends in a north-westerly direction along Chenault Beach Road. The two lines meet at the intersection of Chenault Beach Road and Kamiak Road.

Sewer service in the area is provided by the Olympus Terrace Sewer District.

Electrical power is provided by Snohomish County Public Utility District No. 1. There is no electrical service on the site itself, but single, two, and three phase power is available from lines immediately to the north and south.

Public Services

Police protection is provided by the Snohomish County Sheriffs Department. The department is currently understaffed, and is requesting funds to hire an additional 25 officers for 1979. If funds do not become available for these officers, officials of the Department project that existing facilities and staff will be severely overtaxed.

Fire protection is provided by the Snohomish County Fire District 1. Manpower and equipment are adequate to meet present needs.

To keep up with population growth in the area the Mukilteo School District is presently planning expansion of some facilities in the vicinity of the site. Planned are a K-5 expansion at Olympic View Middle School and a new elementary school in the Lake Serene area.

Transportation and Circulation

No direct access to the site exists; several subdivision roads pass near the site boundary. Access to the site area from I-5 is via SR 525 from the south, and SR 526 and SR 525 from the north. An extension of Interstate 405 is planned that will greatly improve general access to this area. Chenault Beach Road (a Snohomish County road) provides the link between the State Highway and the site. Chenault Beach Road passes through a commercial and industrial area for the first mile, proceeds through a relatively undeveloped area, and finally becomes a residential street in an area of new and recently built homes. Traffic on this road averaged 377 vehicles per day in 1975; the 1978 estimated traffic volume is 475 vehicles. Site access from the existing road network requires driving through a substantial portion of the subdivision on streets with sharp curves and steep grades. No transit service is available.

Navigational Risk

Navigational risks, discussed at length in Appendix A, are summarized briefly here. The South Mukilteo site is currently without any industrial or waterside activity. Because of the north-south alignment of Possession Sound, storm winds act over long fetches, generating waves up to six feet high. The site offers unrestricted access from Puget Sound. Tidal range is 7.5 feet; tidal currents are low. Recreational boating activity in the area is low.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

Excavation and clearing of building sites, roads, and similar

facilities on the site would constitute minor impacts on the geology and landforms. No other impacts are expected. Design of the facilities to minimize excavation and avoid destabilizing the bluff would minimize the geological impacts.

Soils

No long-term permanent impact is expected upon the soils at this site. Compaction of the soil occurring as a result of site preparation and road work might produce sporadic ponding.

Construction activities such as clearing, grading, and cuts along steeper slopes could cause temporarily increased erosion. Increased erosion would result from soil compaction, vegetation removal and impervious surfacing. Further study of existing geology/soil/slope conditions would be necessary to determine design limitations that may be needed on this site. Use of erosion control techniques during construction would reduce construction-related erosion.

Air Quality

Operational air quality impacts would be minimal. Concentrations of sulfur dioxide would increase, especially where the plumes impact the side of the bluff, but no standards would be violated. Total suspended particulate levels would also increase slightly, but resulting levels would be well below ambient air quality standards. Carbon monoxide levels near roads would increase (see Appendix C); however, even under worst case conditions, the expected concentrations would be well within standards.

The impact of sulfur dioxide concentrations on the nearby bluffs could be mitigated by allowing vessels to leave port only when the wind is blowing away from these hills or by modifying the SURVEYOR's equipment. The SURVEYOR would be the major cause of the increased sulfur dioxide because that ship burns a higher sulfur fuel; burning a lower sulfur oil would be a possible mitigative measure. (See also Appendix C.)

Water Quality and Aquatic Biology

Because the South Mukilteo site is exposed to long stretches of open water on three sides, a rock breakwater at least 0.6 miles long around the berthing facility would be needed. (See Figure 2-5.) Depending upon the pier configuration and distance from shore, up to 20 acres would have to be dredged, including the turning basin. Such dredging would generate up to 600,000 cubic yards of spoils, only a fraction of which could be disposed of on-site. Open water disposal might be possible since the chemical analyses of the sediments show that the bottom is composed of relatively clean sand.

Substantial shoreline alteration would be needed. The landward side of the tracks is steeply sloped; therefore, the two acre staging and storage shed area at the head of the dock would be constructed on fill, thereby permanently eliminating two acres of intertidal area.

The dredging and the breakwater would eliminate up to 25 acres of moderately productive, shallow marine habitat. Although considerable turbidity would result from dredging, the tidal currents and the sandy composition of the substrate should assure relatively rapid



Legend
Dredge Area
Breakwater
Soundings in feet

500 0 500 1000 1500
Scale in Feet

Figure 2-5

South Mukilteo Site - Impacts

dispersion and resettling of locally suspended material. Since the dredging would deepen the bottom to 30 feet at MLLW, the scattered eelgrass beds and the extensive sea pen population observed at the site would probably be permanently eliminated.

Some impacts on fish populations are probable. The breakwater, by providing a rocky habitat not presently found at the site, may attract a greater diversity of resident fish than was observed during the diver reconnaissance. On the other hand, the breakwater could impede the migration of anadromous fish, especially juveniles. To minimize interference with migrating fish, the breakwater should not extend all the way to the shore (see Figure 2-5). Such a design would also help assure adequate tidal circulation within the breakwater.

Containment of the infrequent, small, dockside fuel and oil spills would be more of a problem than at the present PMC site on Lake Union because of tidal currents. A larger barrier, anchored in place, would be needed to effectively contain such spills.

Since the upland portion of this site is steep, there is a substantial risk of erosion and resulting nearshore sedimentation. Preventive measures such as detention and sedimentation ponds, and prompt stabilization of excavated slopes should be incorporated during construction. If adequate erosion prevention measures are taken, stormwater runoff would have negligible impact upon the nearshore marine waters.

Terrestrial Biology

Development of the proposed facility at the South Mukilteo site would remove much of the existing vegetative cover and replace it with buildings, paved parking areas, work spaces, and landscaping. Removal of vegetation would eliminate habitat and result in the destruction or displacement of some wildlife species found at the site. Although landscaping incorporated into the final design plan would mitigate the loss of vegetation to some extent, both the diversity and density of animal species would be reduced. Populations of human tolerant species such as sparrows, robins and starlings would increase. This effect would not be significant in a regional context. Although the site is of some biological value as a deciduous woodland habitat, it is not unique in this vicinity.

Natural Resources

Development of the regional center at the South Mukilteo site would not significantly affect availability of any natural resources.

Aesthetics

Development of the NOAA facility at this site would probably not greatly impact the appearance of the area if buildings were concentrated and most of the area was left in native foliage. The offshore structures would be located below the bluff, out of view from the residential areas above. Future plans for the site identify an industrial use with an adjoining dock structure. If designed with consideration given to aesthetics and blending with the natural environment, the facility would probably not significantly impact the existing aesthetic appearance of the site.

Archaeological and Historic Resources

If archeological resources are present on this site, construction needed to develop the proposed facility might destroy these resources. This potential impact could be mitigated by a pre-construction assessment by a professional archeologist and implementing any recommended mitigative measures.

Noise

Construction activities on this site would cause a significant temporary noise impact on nearby residential areas because existing ambient noise levels are low. Outdoor speech interferrence would occur in areas up to 1,000 feet from the site. Peak noise levels as high as 103 dBA may occasionally occur during pile driving or when earth movement is required next to the right-of-way. Such noise levels would be highly annoying to nearby residents.

Vessel activities near the bluff may cause some disturbance to nearby residents because the existing noise levels are very low. Residents further from the bluff would be shielded from vessel noise; therefore, no impacts in these areas would occur. Noise levels in the area would not exceed federal or state noise regulations as a result of vessel activities. Noise emitted by other activities would also be clearly audible to neighboring residents although noise levels would be below applicable standards.

The expected 450 percent increase in the average daily traffic volume on Chenault Beach Road (see "Transportation and Circulation" below) would increase the peak-hour noise level substantially. Nonetheless, these levels are within acceptable guidelines and regulations. Traffic increases on Washington State Route 525 would also increase the noise level slightly.

Demography

Location of the NOAA center at the South Mukilteo site would probably result in the eventual relocation of many of the 2,000 projected employees into South Snohomish County. Many current employees may find an additional 30 mile commute distance too far, and would relocate to South Snohomish County over time. Most new employees would probably locate in the vicinity when hired. Therefore, the currently projected population growth for the area would be realized somewhat sooner than expected.

The present accelerated housing growth rate would continue longer than anticipated to accommodate NOAA personnel and their families. The overall net effect on the total number of new housing units built in the Seattle-Everett area would be minimal. The local unemployment level would probably not be greatly affected since many of NOAA's employees are specifically trained and educated for their positions. Any available positions would be filled according to usual civil service procedures.

Economic Forces

The proposed site is to be industrially zoned. If NOAA were to locate here, that industrial use would no longer exist. With limited industrially zoned properties available, a decision to take industrial

property for this purpose should be evaluated carefully.

The proposed site is privately owned and as such, real estate taxes are assessed and collected on it. If NOAA buys the site, real estate taxes on the property would no longer be paid, resulting in a loss of revenue to the local jurisdiction. The trade-offs among other increased revenues and costs associated with the facility should be considered.

Other economic impacts are no different from those for development of the Everett site.

Land Use

Development of the NOAA facility at this site would not conflict with the shoreline designation or the land use designation if the latter is amended as proposed. The facility would be more compatible with the surrounding uses than industrial uses. Secondary impacts associated with locating employees and their families in the surrounding area would be minimal since there are already plans to accommodate many times the number of persons expected to be employed by the NOAA facility.

Utilities and Energy

Representatives of the Mukilteo Water District have indicated that flows could be provided by a new line extending westerly from the existing 16-inch pipe. A private easement would be required unless a new public road to the site is provided.

Local sewer district officials did not indicate that there would be any problem providing sewer service to the site.

Officials of the Public Utility District advise that overhead power distribution is available in the immediate site vicinity. The steep topography in areas of the site might impose some restrictions, resulting in higher costs, but the extent of this increase would be contingent on final design plans. No significant impacts are expected.

Public Services

The Snohomish County Sheriff's Department is currently understaffed. If funds presently requested to hire an additional 25 officers do not become available, officials of the Sheriff's Department project that the existing facilities and staff will be severely overtaxed. Additional population growth caused by the influx of NOAA employees would add to this problem. If funding is provided, no problems are anticipated in providing service.

The Chief of Snohomish County Fire District 1 does not foresee problems in providing service to the site. Growth plans for the area are presently in a state of flux, making predictions of the future adequacy of fire service difficult. If growth in the south end continues as planned, a new fire station will be needed north of the present Lake Serene location. Also, several road improvements are being planned in the area which would improve response time at the site.

To keep up with population growth in the area the Mukilteo School District is presently planning expansion of some facilities in the vicinity of the site. School district officials estimate that with planned facilities expansion, growth caused by relocation of NOAA employees could be absorbed.

Transportation and Circulation

NOAA traffic would increase the projected traffic volume on Chenault Beach Road by 450 percent. (See Figure F-1c.) If access were developed from the existing subdivision street network, the traffic impact would be adverse to residential living. The additional traffic would create a condition of congested operation during the peak traffic hours. The existing grades and alignments do not lend themselves to smooth, high volume traffic flow. The easterly portion of Chenault Beach Road presents no apparent problems for the projected traffic. The anticipated traffic volumes are well within the accepted capacity values for a well aligned two-lane roadway such as this one. SR 525 is not carrying high volumes of traffic at this time. Projected traffic volumes, including NOAA traffic, are not expected to cause operational problems. No significant impacts on any other roads would be expected.

Direct site access could be developed from Chenault Beach Road in the vicinity of Condon Road. A properly designed road and traffic control would virtually eliminate all NOAA traffic from the residential areas.

Navigational Risk

The South Mukilteo site presents no special navigational risks. The route to the site would cross no ferry routes except those in the main traffic lanes in Puget Sound, which should pose no hazard. In heavy seas the breakwater required at this site could be a hazard for approaching NOAA vessels. Vessel grounding is unlikely after required dredging has been completed.

SECTION 4: KENMORE

EXISTING ENVIRONMENT

Geology and Landforms

The geology of the Kenmore site has been extensively modified by the filling of the marsh that was previously located in this area. Similarly, the landforms on the site have been determined by human activity; the site is presently level and at an elevation of 10 feet above the lake level. The site is bordered on the south by the Sammamish River, on the west by Lake Washington, and on the north and east by higher landforms.

The only geologic hazard on this site is common to the entire Puget Sound region -- seismic damage. If the fill is not properly compacted, the site may be subject to liquefaction of the fill during severe earthquakes.

Soils and Erosion

As mentioned under "geology" above, this site is man-made land; soils on the site consist of dredged material; most of the site is covered with concrete or asphalt. Due to its flatness, the site is not prone to erosion and no evidence of erosion was seen. However, the shorelines are potentially susceptible to erosion.

Climate

The Kenmore site exhibits a

climate much like that described for the Puget Sound region. No significant differences are likely with respect to wind patterns, temperature or precipitation.

Air Quality

Air quality at the Kenmore site is probably within applicable standards. Although no site specific air quality monitoring data are available, locally collected data and a review of nearby pollutant sources can be used to characterize the Kenmore site. Isopleths of total suspended particulate (TSP) concentrations drawn from regional monitoring data indicate that TSP concentrations near the site are below applicable standards; however, the presence of a cement batching plant adjacent to the site make it probable that levels on the site are higher than indicated by the regional data. Carbon monoxide (CO) background at the site (exclusive of nearby sources) was estimated as 1.5 ppm based on the residential community type, the light industry, and proximity to other CO sources. Regional sulfur dioxide data do not indicate that levels exceeding standards occur close to the site.

Water Quality and Aquatic Biology

The quality of the water bodies adjacent to the site is high. The Sammamish River has high coliform levels and high temperatures in the summer. Lake Washington has no significant water quality problems. Significant aquatic populations use the shallows near the Kenmore site.

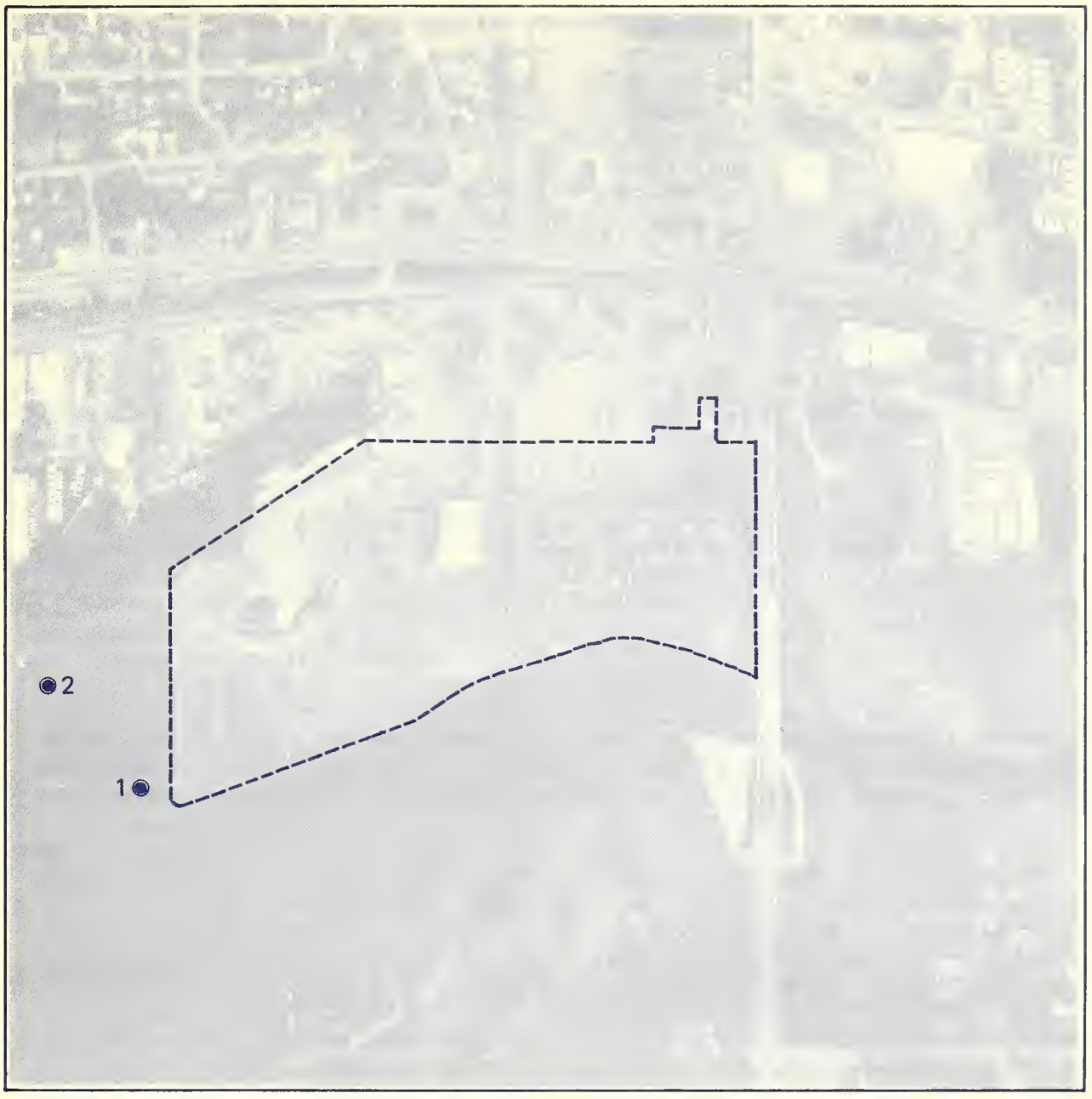
The site (see Figure 2-6) is bordered on the south by the Sammamish River, on the north by a short, dredged waterway, and on the west by Lake Washington. A 50-foot wide buffer strip of vegetation (greenbelt) separates the site from the river and the lake. The Sammamish River has an average flow of 260 cfs and a recorded peak flow of about 1300 cfs. At the north end the lake, deposition of silt by the river has formed a delta that extends about three-quarters of a mile offshore.

A 1976 study (URS, 1976) summarizes historical water quality patterns for the Sammamish River near its mouth. The most significant points regarding the river are: 1) moderately high coliform values, often exceeding 1000 parts per 100 ml; 2) dissolved oxygen levels near saturation at all times of the year; 3) water temperature maximums near 25°C during the summer; and 4) moderate nutrient levels (nitrate: 0.8-4 mg/l, phosphate: 0.05-0.2 mg/l). Because the river is shallow and flows slowly, dense growths of aquatic plants occur during the summer. The river is classified as AA by the Washington Department of Ecology (See Table B-1).

The water quality in Lake Washington is described in the Sand Point site description.

Discharge from the Sammamish River usually spreads across the surface of the lake where, during the winter months, the dominant southern winds force the current around the north shore (METRO, 1977). These winds frequently induce resuspension of sediments in the shallow northern end of the lake, increasing turbidity.

The results of two sediment analyses taken offshore of the site are shown in Table B-6. Clearly, the



Legend | ◉ Sediment Sample Site



Figure 2-6

Kenmore Site - Existing Conditions

two samples differ greatly in composition. One had a high total solids composition and a low organic content. The other had a rather high organic content and higher levels of oil, grease and copper. The high variability in sediment composition may be due to the local pattern of currents and depositional rates; more samples would be needed to determine the actual level of sediment contamination. Nearshore sediment analyses for a marina one-quarter mile to the east of the Kenmore site also indicate rather high organic sulfide levels. (King County, 1977).

This site borders a major adult and juvenile salmon migration route for coho, chinook and sockeye en-route to or from the Sammamish River, and Lake Sammamish tributaries. Chinook and coho salmon from the Issaquah Hatchery also use this migration route. (See Figure B-14 for timing of salmon migration.) There is sport fishing near the site and occasional commercial fishing by Indians. Commercial fishing can occur from July through October.

Although relatively little work has been done to characterize the benthic community near the Kenmore site, the shallow depth in this area and the input of organic material and nutrients from the Sammamish River probably support a more abundant community than found in most of Lake Washington. Benthic communities form an important food base for fish. The shallows may also be an important habitat for adult and juvenile crawfish. Bottom surveys (METRO, 1977) indicate that during the summer the area supports substantial growth of aquatic plants, especially Potamogeton and Eurasian milfoil. An extensive marsh at the north end of the Sammamish River, opposite the site, is thought to be one of the best and most extensive marsh habitats for nesting ducks and other wildlife remaining on Lake Washington (Boomer, 1978).

Terrestrial Biology

Vegetation on the Kenmore site is limited to weeds and grasses; most of the site is presently paved with asphalt and concrete. Small trees (alder and poplars), cattails, blackberries, and Scotch broom occur along the edges of the site on the banks of the Sammamish River and Lake Washington. The site itself does not provide significant habitat for terrestrial wildlife. (See Appendix E for species lists.) The Inglewood Country Club, located across the Sammamish River from the Kenmore site, provides a more suitable habitat for both plants and animals. Additional wooded areas are located within five miles east and south of the Kenmore site. The shallow area adjacent to the site is a major food resource for waterfowl, including coot, canvasback, goldeneye, mallared, pintail, redhead, ruddy duck, scaup, shoveller, teal and goose.

Natural Resources

The Kenmore site, constructed by filling a marsh, has no mineral resources and is not suitable for agriculture. The adjacent shallow area may be an important source of food for fish, as discussed under "water quality and aquatic biology".

Aesthetics

The site presently is used as a storage and barge loading facility.

The site is surrounded by other industrial and commercial uses. A busy and noisy highway passes the site.

Archaeological and Historic Resources

Although shoreline locales were favored by Indians in this area, and archaeological materials may have been present on the site, it has been so extensively distrubed by excavation and filling that no intact resources are likely to be present. No such resources are known to exist on the site.

Noise

Noise levels on the Kenmore site (Appendix D) are in the range typical of areas with light industrial land use. The dominant noise sources near the site are a lumber company, Juanita Drive, and Washington State Route 522. Noise levels seem to be constant along the northern end of the proposed site. Nighttime noise levels are dominated by automobile traffic on Juanita Drive and State Route 522.

Demography

The Seattle-King County region is growing rapidly. The new population is especially attracted to undeveloped portions of King County where they seek a suburban lifestyle. Several housing areas are developing northeast of Kenmore in Redmond, and north of Kenmore in South Snohomish County. Other demographic, housing and employment conditions do not differ significantly from those at Sand Point.

Economic Forces

The Kenmore area is largely dependent upon the Seattle-King County economy. Hence economic forces are the same as those affecting Sand Point.

Land Use

The Kenmore site, presently owned by a private company, is used as a cargo storage and a tug and barge terminal site. Other industrial uses surrounding the site include a sand, gravel and concrete plant and a lumber storage yard. Along the waterfront, adjoining uses include a seaplane base and marinas. A residential community overlooks the Kenmore industrial/commercial area and Lake Washington beyond.

King County has jurisdiction over the site and the shoreline. The site is zoned for light manufacturing. King County has designated the shore line adjacent to the site as "urban", a designation which permits such actions as industrial development, dredging, and construction of bulkheads and piers. Prior to development of the King County Shoreline Master Plan, land use along shorelines was regulated only by land use zoning. Before King County developed a Shoreline Master Plan, a citizens advisory group developed a document called the "Lake Washington Regional Goals and Policies". That document is discussed in the land use section of the Sand Point discussion.

There is presently a proposal to develop a marina at this particular site (King County, 1978).

Utilities and Energy

Water service is provided by Water District #79. There is an existing 12-inch water main along 68th Avenue N.E. from N.E. 170th

Street to N.E. 175th Street with an estimated fire flow capacity of 4,000 gpm, and an 8-inch water main along N.E. 175th Street from 61st Avenue N.E. to 68th Avenue N.E. with an estimated fire flow capacity of 2,800 gpm. In addition, there is a private 8-inch line running south from N.E. 175th Street that provides fire flows for the warehouse located on the site. Flows in this line are estimated at 2,500 gpm.

Sewer service at the Kenmore site is provided by the Northeast Lake Washington Sewer District and the Municipality of Metropolitan Seattle (METRO). There is an existing 8-inch diameter side sewer line from the warehouse located on the site, running north to N.E. 175th Street and into a 78-inch diameter METRO interceptor. To the east of the site, a 27-inch interceptor runs north to a connection with the 78-inch interceptor. Sewage from these lines enters the Kenmore Pumping Station immediately north of the site. The pumping station is presently near capacity. METRO is currently seeking federal funds for improvements to increase the capacity of this pumping station.

Power is supplied by Puget Sound Power and Light. Both single and three phase power are available at the site.

Public Services

Police protection is provided by the King County Police Department.

Fire protection is provided by King County Fire District No. 16. Officials of the District indicate that there has been increasing pressure on the existing fire protection service in the area due to development. The District is currently operating with minimal manpower, having 11 full-time, paid firefighters and 8 to 10 volunteers. One third of the firefighters are on duty at a time, and generally eight or fewer volunteers respond to each fire. In general, available land-based equipment is adequate; the only water-based equipment is a 33 foot crash and rescue fire boat with 500 gpm pumping capacity. This is used for assisting small water craft. Funds are not available at present for expanding fire service in this area.

Officials of Northshore School District #417 have indicated that enrollment is increasing rapidly, and substantial future enrollment growth is expected. Existing schools of the District are at capacity, one new elementary school is being constructed at present, and other facilities are planned for construction over a four year period to provide for some growth in enrollment.

Transportation and Circulation

Site access is provided by 175th Avenue NE, a two-lane, two-way road that parallels SR 522 in the site area and serves primarily as a local access road for the abutting industry. The intersections of 175th Avenue NE with Juanita Drive and SR 522, near King County's Logboom Park, are signalized. These intersections are approximately 340 feet apart and are separated by a railroad crossing. No traffic volume records are available for 175th Avenue NE, but adjoining land use and observed traffic volumes indicate that no operational problems presently exist. Traffic volume on Juanita Drive is about

21,000 vehicles per day and SR 522 serves about 33,000 vehicles per day in this area. Severe operational problems exist on SR 522 during peak traffic volume periods. The area is served by both express and local bus service, provided by METRO transit; buses to N.E. Bothell Way and 68th N.E. run at least every hour, and are more frequent during peak hours.

Navigational Risk

The navigational risks associated with the Kenmore site are slightly greater than those for the Sand Point site. Tugs and barges presently operate near the Kenmore site, which is also adjacent to a seaplane base and a large marine sales operation. An environmental impact statement for a proposed marina in Kenmore recognized the present conflict of competing uses along the shoreline.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

No significant impacts on the geology of the site are expected. A portion of the site would be excavated, as shown in Figure 2-7.

Soils

No significant impact is expected on the soils at this site. During construction, short-term storage of soil, rubble, and wet dredged material might require containment berms and mounds of material on the site. Much of the existing pavement would either be removed or covered with soil as a part of site preparation and alteration.

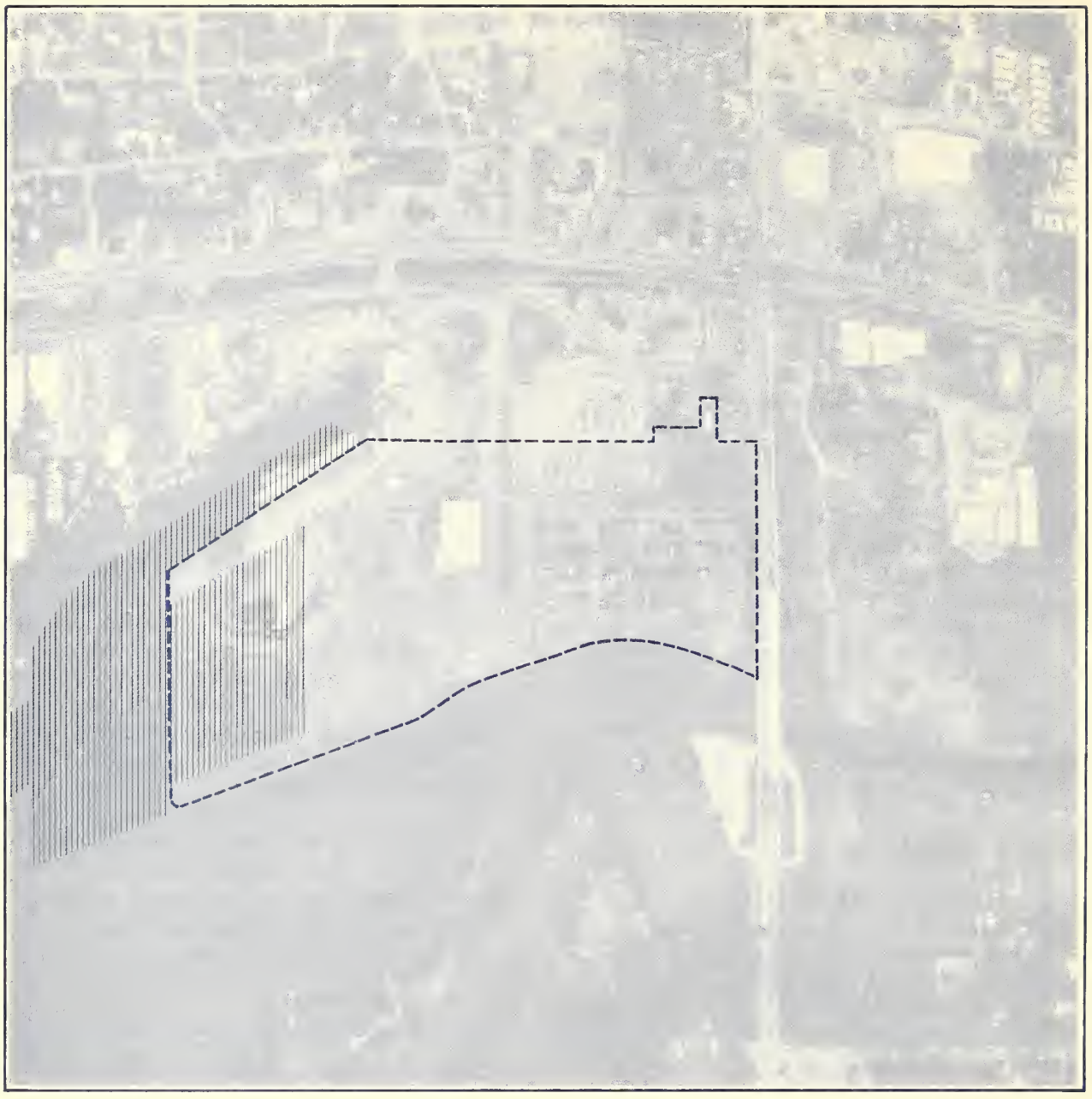
Air Quality

Operations would generate air pollutant emissions from both ship operations and automobile traffic. Ship operations would increase levels of sulfur dioxide and total suspended particulates (TSP). (See Appendix C.) No violation of sulfur dioxide standards is expected. Whether TSP standards are exceeded would depend upon actual levels generated by the cement plant and whether emissions from the ships interact with those from the plant. Berthing the ships at the Kenmore site would require passage through Lake Washington and the Ship Canal.

Carbon monoxide (CO) analyses at three locations near the proposed site (Appendix C) indicate an anomalous situation in that the 1 hour standard would be exceeded immediately above State Route 522 west of Juanita Drive Road, but the 8 hour standard would not be exceeded. At 10 meters from the roadside the 1 hour value becomes 29.5 ppm, which is below the standard. Potential mitigative measures to reduce CO levels would include carpools and other means to reduce traffic volume, such as staggering hours of workers.

Water Quality and Aquatic Biology

Impacts on water quality and aquatic plants and animals would be mainly due to required dredging. A substantial amount of dredging would be required -- about one million cubic yards of material would have to be dredged from 28 acres of lake bottom to provide ship access (see Figure 2-7). Some of the dredgings could be placed upon the site if



Legend | Dredge Area

500 1000

Scale in Feet

Figure 2-7

Kenmore Site - Impacts

found suitable as foundation material; however, most of the dredged material would have to be disposed of off-site. Because of the high organic oil and grease content in the sediment and a high proportion of silt, upland disposal would probably be required. Since appropriate disposal sites along the Lake Washington shoreline are virtually nonexistent, dredge barges would have to be hauled a considerable distance.

The deposition of silt carried into the lake by the Sammamish River, as well as resuspension and settling of wind induced turbidity would necessitate maintenance dredging to keep the channel and turning basin at the required 30-foot depth.

Dredging would adversely affect aquatic biota both directly and indirectly through increased turbidity. During the dredging operation a considerable amount of fine, silty material will be put into suspension. Much of this material will resettle in the vicinity of the dredging; however, a substantial turbidity plume is likely to spread from the site since the very fine clays will remain in suspension for several days. This turbidity might adversely affect fish migration in the Sammamish River. Although tests conducted by Patten (1975) showed that highly turbid lake water did not kill Coho juveniles or prickly sculpin over a five day period, these species did show a tendency to avoid areas of high turbidity. Means to mitigate these dredging impacts are discussed in the secton on "regional environment".

The dredging would eliminate 28 acres of shallow lake bottom habitat (10 feet in depth, or less). Patten, et al, (1976) found the greatest numbers of benthic invertebrates at shallow depths. Because it is shallow and receives a large input of organic matter from the Sammamish River, the north end of Lake Washington is probably a relatively productive area that supports considerable resident fishlife. The dredging would permanently deepen about five percent of the shallow area at the end of the lake to 30 feet. The dredged area would recolonize, but it is likely that the population would be about three to ten times lower. In addition, maintenance dredging would periodically disrupt the habitat. The 30 foot depths should effectively eliminate the growth of aquatic macrophytes, including Eurasian milfoil, in the dredged areas.

Several species of resident fish spawn or grow to adult form in the shallow areas of Pontiac Bay at Sand Point (NOAA, 1976); if this is also true for the shallows at the north end of Lake Washington the dredging project would result in a reduction of such habitat.

Since the lakeside portion of the site is already filled to the outer harbor line, slips would have to be excavated into the site to berth some of the ships. 900 feet of the vegetative buffer strip presently growing on the lakeward side of the site would be replaced with 1,500 feet of bulkhead and rip-rap. The use of pilings rather than bulkhead fill in the slip design would avoid long, narrow pockets of water, which generally create circulation and fish entrapment problems.

Given the relatively small flow of the Sammamish River and the fact that the ships will be berthed in

channels outside the open lake, water currents will be rather small. An oil boom system like that presently used at the Lake Union Center should be sufficient to contain any small dockside spills. Prompt cleanup of such spills would be necessary to avoid damage to the marina to the north or to the marsh to the south.

Provided that care is taken during dredging and construction there will be little physical impact upon these marsh. Retention of the 50-foot buffer of natural vegetation along the southern edge of the site that fronts the river would minimize long-term impacts to both the marsh and anadromous fish runs. Nevertheless, the removal of over 20 acres of shallows near the marsh would reduce the feeding area for marsh residents, especially ducks. During operation of the facility no significant water quality impacts that would threaten the marsh are expected. Stormwater runoff from the 37 acre site may increase the pollutant load to the northern part of the lake; however, the additional loading would be only a very small fraction of the loads presently entering the lake from surrounding industrial, commercial, urban and farm areas.

Terrestrial Biology

Development of the proposed facility at Kenmore would reduce the food supply (Potamogeton) available to a variety of waterfowl, possible significantly reducing the carrying capacity of the area. In addition, 900 feet of vegetative buffer along the lake would be removed. Landscaping associated with the facility would enhance the site itself as wildlife habitat for some species tolerant of human activities. This impact would not be of regional significance.

Natural Resources

No significant impacts on mineral resources would occur. Impacts related to fisheries have been discussed in the section on aquatic biology.

Aesthetics

A landscaped NOAA office complex with adjoining ship moorage would change the appearance of the site from the present industrial and barge transit use. The docking structures and moored ships would be visible to some area residents from a distance.

Archaeological and Historic Resources

No impacts are expected.

Noise

The residental area south of the Kenmore site will experience some construction noise impacts because the only existing noise sources nearby are the seaplane and motor boat activity on Lake Washington. Construction noise levels in this area would be comparable to those discussed for the South Mukilteo site.

The area north of the site will be shielded from construction noise by Washington State Route 522, existing terrain, and the distance attenuation of noise. Land use east and west is compatible with expected construction noise levels.

Operational noise levels would be within limits established by state and federal criteria. Noise levels caused by vessel movement will cause increased noise levels in the residential area on the southern bank of the Sammamish River. Noise levels of up to 65 dBA at 750 feet would occur infrequently when Class I NOAA vessels dock (16 to 20 times per year). Noise impacts to the north will be shielded by a road embankment and Washington State Route 522. Noise levels would increase slightly in the residential area south of the site. No increase in noise levels on major site access roads would be caused by vehicle traffic (Table D-3).

Demography

Location of the NOAA Center in Kenmore would have little impact on population growth, housing, or unemployment levels in the Seattle-King County area since NOAA operations are presently located in Seattle. Locally, however, such impacts are likely; over time, some NOAA employees would probably relocate closer to the facility, stimulating the residential development now occurring north and northeast of Kemmore.

Economic Forces

The proposed site is industrially zoned. If NOAA were to locate here, that industrial use would no longer exist. With limited industrially zoned properties available, a decision to take industrial property for this purpose should be evaluated carefully.

The proposed site is presently being used by industry. If NOAA locates here, it would displace workers and the industry itself.

Because the proposed site is privately owned, real estate taxes are assessed and collected on it. If NOAA buys the site, real estate taxes on the property would no longer be paid, resulting in a loss of revenue to the local jurisdiction. The trade-offs among other increased revenues and costs associated with the facility should be considered.

It is expected most NOAA employees would continue to live where they are; however, some NOAA employees would probably locate closer to Kenmore over time. Revenues to King County would be augmented by the increase in real estate values, as houses are built, and by increased sales and business and occupation tax revenues, as services and commodities are supplied. These cost benefits will have to be compared to the increased costs for supplying roads and utilities to the facility itself and to new housing areas as a result of the proposed project.

Retaining NOAA in the Seattle area would assure continued federal employment and a continued diversified employment base. Most NOAA employees and their families would continue to live in their present homes, thereby avoiding the associated monetary and environmental costs of relocation.

Land Use

The NOAA facility would be compatible with the King County Shoreline Master Plan, zoning, and surrounding land use. The NOAA facility would not be consistent with a citizen group's "Lake Washington Goals and

Policies". There would be no secondary impacts associated with relocating employees and their families in the surrounding area since most of them are already working and living in the Seattle area.

Utilities and Energy

The general manager of Water District #79 has indicated that the existing system is adequate to supply NOAA's estimated total combined fire and domestic flow requirements from a connection on 68th Avenue N.E. This can be accomplished without increasing pipe diameter, or providing additional water sources or storage capacity (Greimes, 1978).

Representatives of Northeast Lake Washington Sewer District and METRO have indicated that the existing system could handle NOAA's expected flows. The facility could be served from the north through a private easement into METRO's Kenmore Interceptor. This connection would be down pipe from the Kenmore Pumping Station and, thus, would not increase flows into the pumping facility. A private pump would be needed to move sewage into the interceptor.

Representatives of Puget Power have stated that they would not anticipate any problems in supplying energy to meet NOAA's demands.

Public Services

Officials of the King County Police Department do not anticipate any problems in handling increased calls for service caused by relocation of NOAA employees to the area. Increases in manpower and equipment might be needed, and would be supplied as demands indicate a need.

Officials of King County Fire District No. 16 indicate that there has been increasing pressure from development on the existing fire District is currently operating with minimal manpower. Funds are not available at the present time for expanding fire service in this area. In addition, private water mains would have to be installed during construction to provide fire flows for all buildings more than 200 feet from existing roadways.

Since the facilities of Northshore School District #417 are barely keeping up with the rapidly increasing enrollments, relocation of NOAA employees and their families within the District would add to the burden on the present facilities. Officials of the Northshore School District estimate that if all students expected as a result of NOAA relocation report for school in a given year, the impact on school facilities would be serious.

Transportation and Circulation

NOAA traffic would increase the existing daily traffic volumes in this area less than 10 per cent (See Figure F-1C). NOAA traffic would generally be opposite the existing rush hour traffic flow, helping to equalize the vehicle flow. No adverse traffic operational impact would be expected.

Use of the Kenmore site would increase bridge openings along the Lake Washington Ship Canal, disrupting traffic across this corridor. By avoiding transits during the peak hours, traffic disruption would be minimized.

Navigational Risk

Navigational risks for the Kenmore site are somewhat higher than those at Sand Point because of the recreational and commercial usage of waters near the site. Other risks are discussed under Sand Point.

SECTION 5: SAND POINT

EXISTING ENVIRONMENT

Geology and Landforms

This site has been substantially modified by filling. The geologic units under the fill are probably recent alluvial materials and glacial drift material (sand and gravel) (Liesch, et al, 1963).

The site (see Figure 2-8) is surrounded by water to the north and east, and by higher landforms to the south and west. View Ridge rises abruptly to the west of the site, reaching a maximum elevation of 360 feet. The ridge descends abruptly to the north into the Thornton Creek watershed and falls off gradually into Hawthorne Hills to the south. The 220-foot hill location of the Windermere neighborhood is separated from Hawthorne Hills by a deep depression. The site itself is relatively flat, ranging from shorelines of 2 to 5 feet above water level to maximum elevations of 25 to 26 feet at both the southwest corner of the site and the control tower.

No geologic hazard, other than the regional seismic hazard discussed under "regional geology", has been identified. Previous use of the site as a naval air station suggests that differential settlement due to seismically induced liquefaction is unlikely to be a problem on this site.

Soils and Erosion

Soils at the Sand Point site are mostly sandy and silty loams. They are generally conducive to rapid water transfer but are not suitable for supporting heavy loads. Approximately 70 percent of the site is presently covered with concrete or asphalt, underlain by gravel and crushed rock. Surface and subsurface soil conditions have been determined to be satisfactory for NOAA center requirements (NOAA, 1976). No present erosion problem is evident on the unpaved portions of the site.

Climate

The Sand Point site, located slightly inland from Puget Sound, is protected from stronger breezes experienced on the Puget Sound shore. In general, however, the climate of the Sand Point site is not significantly different from the general regional climate.

Air Quality

The site, which lies within a residential and college community having no major pollutant sources, presently has no air quality problems. Data from nearby stations and a review of nearby sources indicate that concentrations of total suspended particulates, sulfur dioxide, and carbon monoxide are below applicable standards. Because of the traffic volumes on Sand Point Way, the background level of carbon monoxide at the Sand Point site was estimated at 2 ppm.



Legend | Soundings in feet



Figure 2-8

Sand Point Site - Existing Conditions

Water Quality and Aquatic Biology

The Sand Point site encompasses a portion of Pontiac Bay located on the north side of the point. This small embayment of Lake Washington slopes off rather gradually, creating a shallow area offshore (Figure 2-8). The nearshore area is composed largely of gravel and coarse materials. Further out the bottom is characterized by a silt layer overlaying consolidated gravel and sand. The original shoreline has been partially filled and extended underwater in three areas; the largest extension is a 50 by 275 foot ramp. Bulkheads and a seaplane ramp have further altered the shoreline.

Lake Washington as a whole has been extensively studied. Historically, a nutrient poor lake with little plant and algal growth or well-oxygenated, clear water (Sheffer and Robinson, 1939), the lake was enriched by the discharge of sewage effluent. Frequent and intense algal blooms resulted. Diversion of sewage effluent to Puget Sound, begun in 1957, brought a rapid recovery (see Figure B-1). Levels of nutrients used by algae and algal concentrations are now moderate.

The water adjacent to the Sand Point site is used by many species of fish. An intensive study of fish in the Sand Point area (NOAA, 1976) identified 19 species (listed in Table B-7). The study concluded that the shallow areas attracted certain species of resident fish and that Pontiac Bay is used for the spawning and rearing of juveniles. Fish were least abundant in the area during the winter months and much more abundant in the spring. Species that spawn or rear in the area include peamouth, squawfish, largemouth bass, bullhead, yellow perch, prickly sculpin and stickleback. Beach spawning by sockeye salmon may also occur in water adjacent to the site.

A survey of benthic invertebrates (Patten, et al, 1976), found that insect larvae and aquatic worms were dominant in terms of numbers. These species were much more abundant at a depth of 10 feet than at deeper depths. Amphipods were found in large numbers at the shallower depths whereas substantial numbers of fingernail clams were found down to 50 foot depths. Crayfish remained in deep water during the winter, but, like many resident fish, migrated to the shallows during the late spring; they were abundant in rocky areas. Aquatic plants, which occurred at depths up to 12 feet, tended to reach maximum growth in August with deterioration setting in by the end of September. A 1977 study (METRO, 1977) of aquatic macrophytes in Lake Washington found moderate amounts of Potomogeton and Nymphaea in Pontiac Bay.

Terrestrial Biology

The Sand Point site provides a more suitable wildlife habitat than most of the alternative sites located in urban areas, even though much of the site is paved. Vegetation is dominated by tall grasses, sedges, vetch, clovers, plantain, horsetails, and similar "weedy" species. Lupine, Scotch broom and small deciduous trees of various species are also common. This habitat is used by a variety of birds that favor a grassy, open environment adjacent to freshwater (NOAA, 1976). Birds are most abundant on the Southern portion of the site where the vegetative cover is more extensive. Mammals likely to use the site include raccoons, mice, rabbits and skunks. Observations

at the site indicate that mammal densities are relatively low for an area of this size. (See Appendix E for species lists.)

In a regional context, the portion of the Sand Point owned by NOAA may be compared with the adjacent City Park and Naval Support Activity, and with the surrounding residential areas. The City Park includes more unpaved area and shoreline; thus it is potentially more valuable as habitat. The area surrounding Sand Point is principally single family residences; associated vegetation provides suitable habitat for human tolerant species such as robins, house sparrows, crows, starlings, squirrels, and mice.

Natural Resources

The Sand Point site is largely man-made land; hence no natural resources are present.

Aesthetics

The site's use is presently in transition from a deteriorating former Navy airstrip and control tower to whatever ultimate use will be made of the site. The fate of the site is unknown at this time; suggested uses for the site have included NOAA's facility, an in-city airstrip, or annexation it to the adjacent regional park. From the site's lowbank waterfront shoreline of Lake Washington, Mount Rainier can be seen. Many exclusive residential communities now view the site, the adjacent park, Navy facilities, and the lake beyond from surrounding hillside developments. Boaters and residents across the Lake see the large hangers, control tower, and Naval Support Activity buildings. Unrelieved by surrounding trees, these buildings present a strong visual contrast to the residential developments on the hills west of Sand Point.

Archaeological and Historic Resources

The site has been so extensively disturbed by past development that the existence of any material of archaeological importance is improbable. No known resources are present.

Noise

The area surrounding the Sand Point site is predominantly residential; the dominant noise source in the area is vehicular traffic on the major arterials and motor boat activity on Lake Washington. Noise levels near the site are within the normal range for residential areas, except on Sand Point Way. Average daytime noise levels along Sand Point Way were slightly higher than generally found in residential areas (NOAA, 1976).

Demography

The Seattle-King County region is growing rapidly. The new population is especially attracted to undeveloped portions of King County where they seek a suburban life-style. For this reason, until very recently the population of downtown Seattle has actually been declining since 1960, while the region has been growing. King County recently reportedly had over 1,164,000 people in 1977 (a 25 percent increase over the 1960 population). Like Everett and Snohomish County, the area was affected by the Boeing Company's early 1970 economic downturn and consequent layoffs.

Boeing Company is once again thriving and actively hiring in the region, and the regional economy has become more diverse. The projected 1990 population of the King County region is reported to be 1,465,200. Reflecting the prosperity of the region, housing availability is low although new housing construction is at record levels. The unemployment rate (April, 1978) in the Seattle area is 5.5 percent, which is below the nation-wide average of 6.0 percent.

Economic Forces

The Seattle area is economically dependent upon commercial airplane manufacturing, transportation equipment, fabricated metal production, machinery, forest products, and food production. The area has a healthy mix of manufacturing and government employment. The Seattle economy does, however, lack diversity and is heavily dependent upon a single company, (Boeing) which employs over 48,000 people. This weakness in the economy became exceedingly apparent in the early 1970's when Boeing cut employment drastically, causing a serious recession in the area. The next largest employer in the region is the University of Washington with 12,745 employees, followed by the federal government with 8,000 employees.

Land Use

The federally owned Sand Point site is under the authority of the National Oceanic and Atmospheric Administration (NOAA). The hangars and control tower are being used as temporary office space for 180 NOAA employees. The site, and an adjacent 212 acre parcel of land that was given to the City of Seattle for a regional park, was previously used as a naval air station. The Navy has retained some bordering property for a Naval Supprt Activity, commissary, and other military facilities.

The City of Seattle has jurisdiction over the shoreline and land use of the surrounding area, most of which has been designated for residential use (RS-7200). Most of the area is fully developed with single family residences, condominiums, and apartment houses. Property values in the area are high because of the proximity to and views of Lake Washington and the Cascade Range.

The City of Seattle has designated the shoreline adjacent to the site as "Conservancy Management" which permits such uses as "open wet moorage", research and educational facilities, some dredging, and bulkheads. Under this shoreline designation, pilings, dredging and landfilling in excess of 1,000 cubic yards are allowed as special uses; however, no major servicing or repair of vessels is permitted in these locations. Backfill is allowed in the CM classification if it is incidental to and required for bulkhead or riprapping. A special use must satisfy the following requirements:

- The use will not have a significant adverse effect upon the environment or other adjacent or nearby uses, or such adverse effects can be mitigated or the benefits of permitting such use outweigh such adverse effects.
- The use will not interfere with public use of public shorelines.
- Design and appearance of the development will be compatible with the design and appearance of surrounding uses, and;

- The use will not be contrary to the general intent of the Shoreline Master Program of the City of Seattle.

Prior to development and adoption of the Seattle Shoreline Master Program, zoning controlled shoreline development. Soon after the Shorelines Management Act became law, Governor Evans appointed an advisory group of citizens representing all jurisdictions surrounding the Lake to develop recommendations for regulating use of the Lake. This group, which was strictly advisory, developed a set of recommendations, The Lake Washington Regional Shoreline Goals and Policies. Following two public hearings on these recommendations, they were formally adopted by the Citizens' Advisory Group. The primary goal identified by the citizens advisory group was that "the natural amenities and resources of Lake Washington are to be conserved in a predominantly recreational/ residential environment with adequate access available to the public."

A few of the policies they identified to protect the lake are listed below:

- physical structures within the lake should not harm water circulation or aquatic life;
- landfilling and dredging should be discouraged;
- the surface area of the lake should not be reduced by any project;
- construction of new or expanded piers should generally be discouraged;
- bulkheads should be sloping riprap rock;
- the length, width, and height of overwater structures should be limited to the smallest reasonable dimensions;
- moorage, storage, servicing and operation facilities for ocean going or commercial ships and barges should not be expanded on the shoreline of Lake Washington;
- shoreline development should be designated to minimize the obstruction of scenic views while providing for viewing of shoreline areas from viewpoints and other facilities available to the public;
- marinas and other commercial boating, shipping, or barging facilities should be limited to commercial or industrial areas. Day moorage may be permitted in recreational areas, except in unique or fragile areas.

In 1973 the Lake Washington Regional Citizens Advisory Committee (a group of 30) passed by a vote of 11 to 7 a resolution that included the following statement: "The NOAA proposal for campus-like research facilities on surplus properties of the Sand Point Naval Air Station would be compatible with regional goals and policies, but urges NOAA to consider alternative, more appropriate sites for the moorage of its ocean-going vessels."

Subsequently, the City of Seattle developed its Shoreline Master Program, which identified a NOAA facility at Sand Point. This program was approved by the Washington State Department of Ecology after evidence of citizen participation in the development of the plan was provided.

Utilities and Energy

Water service is provided at the Sand Point site by the Seattle Water Department. Sand Point Way N.E. contains a water main that varies in size from 12 inches to 16 inches. North of N.E. 175th Street the water main is 12 inches in diameter from about 1,000 feet; north of that point the watermain is 16 inches in diameter. Water pressure is about 116 psi (static).

Sewer service is provided by the City of Seattle. There is an existing sanitary interceptor on Sand Point Way N.E. Storm drainage could be discharged directly into Lake Washington or into the existing 48-inch City storm drain on Sand Point Way N.E. Power is provided by Seattle City Light.

Public Services

Police protection in the City of Seattle is provided by the Seattle Police Department. The Seattle Fire Department provides fire protection services in the City of Seattle. Schools are operated by the Seattle School district. Enrollments in the district have been declining over the past few years; hence, available facilities exceed needs.

Transportation and Circulation

The Sand Point site is well served by surface arterials. Primary access is expected to be Sand Point Way, which is a four lane arterial through the site area. Two of the entrances to the Naval Support Activity (NSA) base from Sand Point Way are signalized. NE 65th Street is an east-west street that provides access to I-5. Sand Point Way south of the site provides access to the University of Washington and SR 520. The north gate to the NSA occasionally has traffic operation problems caused by traffic leaving during the late afternoon. A manual override for the traffic signal has been installed in the guard house to provide longer time for traffic to exit the base. Frequent bus service to the site is available.

Navigational Risk

Recreational activities near the site will include swimming and water skiing at the nearby Magnuson and Mathews Beach Parks. The navigational risks associated with the Sand Point site and its access route, discussed in detail in Appendix A, are summarized here. Access to this site requires passage through the Lake Washington Ship Canal (LWSC) and the north end of Lake Washington. Transit into Lake Washington from Puget Sound requires passage through the Hiram M. Chittenden Locks and five bascule (lift) bridges. Commercial activity is greatest from Lake Union to the Sound. Recreational activity is very heavy in Lake Washington and somewhat lower in Lake Union; activity varies seasonally, with peak levels on summer weekends.

The character of Lake Washington until the 1950's was primarily industrial, with substantial industrial and commercial development along the lake shore, especially on the east side. Prior to completion of the Mercer Island Floating Bridge, commercial ship traffic also included passenger and freight ferries. Completion of the locks and LWSC in 1914 opened the lake to increased commercial use. The heaviest industrial use of the lake occurred in the 1940's, when the Lake Washington Ship Yard at Houghton (near Kirkland) was building and repairing many ships. During World War II, the Shipyard constructed four net tenders, twenty-five Sea-Plane tenders, and one Destroyer

tender for the navy, and did considerable repair work to Navy ships, Army transports, and commercial ships. The largest ships to transit the Lake Washington Ship Canal were four T2 tankers with a beam of 74 feet and an overall length of 525 feet. After the war, like many other shipyards across the nation, the Shipyard closed because of adverse economic conditions.

A trend toward greater recreational than commercial use of the Lake began after the war years. This change was enhanced by the cleanup of the waters by METRO and by population growth in the Seattle area. A short-term resurgence of commercial use occurred during construction of the Aleyeska Pipeline. Presently, tugs with barges or log rafts are the largest commercial vessels regularly using the Lake and the LWSC. Commercial transits of the Lake are not restricted but the trend of discouraging construction of large ship piers and expanding industrial activities is evident in several shoreline management plans and programs.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

Impacts on the geology and landforms of this site would be minimal.

Soils

During construction a short-term shortage of soil, rubble and wet dredged material might require containment berms and mounds of material on the site. Most of the present pavement would either be removed or covered with soil as a part of site preparation and alteration. This material and the dredged material would be used on the site for construction of hills, berms, and related landscaping forms. Use of appropriate erosion control methods during construction would mitigate increased erosion hazards due to construction.

Air Quality

Operational air quality impacts would be slight. Sulfur dioxide and total suspended particulate levels would be increased by ship operations (see Appendix C); however, no exceedance of standards would result when these emissions are added to estimated background concentrations. Traffic volume would increase, raising carbon monoxide levels near roads (see Appendix C). Nonetheless, even under worst case conditions the expected concentration would be well within levels established by applicable standards. Berthing the ships at the Sand Point site would require passage through the Lake Washington Ship Canal. Pollutant levels generated along this route would be less than those generated in port while preparing for departure.

Water Quality and Aquatic Biology

The most significant impacts on water quality and aquatic biology would result from dredging. Construction of the proposed facility at Sand Point would require dredging 360,000 cubic yards of material from 13 acres in Pontiac Bay (see Figure 2-9). Dredging impacts would be similar to those discussed for the Kenmore site. Unless preventative measures were taken during dredging, silt would be suspended and a turbid plume would spread from the site. The extent and direction of the spread would depend upon a complex interaction of lake currents, wind and lake bathymetry. If confined to the winter months, the dredging would



Legend
Dredge Area
Soundings in feet

500 1000 1500
Scale in Feet

Figure 2-9
Sand Point Site - Impacts

have the least effect upon migrating fish and benthic invertebrates; the winter biomass of the latter was 10 percent to 30 percent of the summer biomass (Patten, et al, 1976).

Dredge spoil disposal would be ashore on Sand Point; the fill would be used to landscape the flat, relatively featureless terrain of the old airport. Thus, no additional aquatic habitat would be disturbed.

The dredging would result in a permanent loss of a substantial portion of the shallow area of Pontiac Bay. Patten (1976) indicates that reestablishment of the benthic invertebrate community would take about two years; however, the biomass of the reestablished population would be considerably less since denser populations were noted in shallower water. Protection of the remaining littoral areas of Lake Washington is necessary to maintain the Lake's fish habitat. The benthic invertebrate produced in these waters are an important food source for juvenile sockeye salmon and other fish.

Deepening a portion of the shallow area of Pontiac Bay would reduce the size of an area known to be used for spawning and rearing of several resident species of fish and remove an area that may be used for sockeye beach spawning (NOAA, 1976). The pilings under the piers would be widely spaced and should not hinder fish migration; in addition, they may provide habitat for a larger population of spiny ray fishes. An increase in the number of these fish might, however, lead to increased predation on sockeye salmon.

Since the major water quality/aquatic biology impacts would be due to dredging, the "staging pier" mitigative measure discussed below under "Navigational Risk" would do little to reduce water quality/aquatic biology impacts at Sand Point. Similarly, unless dredging requirements were reduced by the "small vessels only" measure, the impacts would be the same. For either measure, of course, total impacts would be greater since some location in addition to Sand Point would be affected.

The water quality impacts of long-term facility operations are expected to be minor. The pollutant load of stormwater runoff from the site (if it is properly stabilized and landscaped) would be insignificant in comparison to the total pollutant load due to runoff from surrounding urban areas; the incremental impact upon lake water quality would not be measurable. Oil containment booms similar to those now in use at the Lake Union Center would ensure that the infrequent, small dockside fuel spills can be cleaned up, and aquatic biota in areas adjacent to the site would not be harmed.

Concern has been expressed that passage of NOAA ships into Lake Washington might contribute to the further spread of Eurasian milfoil, a serious problem in Lake Washington. This rooted aquatic weed grows over large areas of shallow water in masses so thick that the recreational uses (and possibly the suitability for fish habitat) are greatly reduced. The greatest depth at which this plant has been observed in Lake Washington is 16 feet (Perkins, 1978). NOAA ships will be confined to channels almost twice as deep; hence the probability of ships encountering healthy masses of Eurasian milfoil, breaking them up and distributing the plant throughout the lake is remote. Although a NOAA ship could pick up small amounts of the milfoil in Union Bay and release them while

docked at Pontiac Bay (where the plant could take root and spread), any of the hundreds of boats, recreational and commercial, that regularly pass through Lake Union to Lake Washington could also spread the plant. Furthermore, spreading of the milfoil by shallow-draft power boats not confined to deep channels would be much more probable.

Terrestrial Biology

Development of the proposed facility at Sand Point would temporarily disrupt much of the existing terrestrial habitat, displacing or eliminating animal species. Since a large part of the 114 acre site would be landscaped with grasses and native tree and shrub species, diversity of vegetation and habitat would increase. Although use of the site by species sensitive to human activities would be reduced, the increased vegetational diversity would provide habitat for a larger number of species than presently use the site, as well as for higher densities of some species. The newly vegetated areas would be colonized by wildlife typical of the surrounding area. Elimination of the present vegetation would reduct the amount of unmaintained grassland habitat available in the area.

Natural Resources

Natural resources on the site would not be significantly affected by development of the NOAA Center.

Aesthetics

The anticipated low-rise, campus-like, landscaped upland NOAA facility would replace the now deteriorating flight strip. In contrast, the proposed waterfront development which includes piers, would be seen at the edge of the lake itself. Views of Sand Point itself from the water and from residential areas on the east side Lake Washington would be more compatible with the residential character of the area. The ships and moorage facilities would also be clearly visible. Whether the average mooring of two ships (increasing to twelve for two months in the winter) would be considered attractive depends on the viewer. The "staging pier" mitigative measure discussed in the "Navigational Risk" section would reduce the required shoreine alteration, since only one pier would be needed.

Archaeological and Historic Resources

No impacts are expected since no such resources are known to be present at Sand Point.

Noise

Construction of the proposed facility would cause a noticeable temporary increase in noise levels in residential areas near the facility. Intermittant noise levels as high as 75 dBA may occur during pile driving activities.

Operational noise levels would be within limits established by state and federal criteria. Noise emissions from Class I vessels would cause increased noise levels in residential areas west of the site; however, these levels would occur infrequently (16 to 20 times a year). Increased traffic levels would not significantly affect noise levels in residential areas.

Land Use

The NOAA facility would be compatible with the Seattle Shoreline Master Plan. The site is zoned for residential use by the City of Seattle even though the City has no zoning jurisdiction over federal properties. The NOAA facility is not consistent with a residential zone but neither are Magnuson Park, the Naval Support Activity or the former Naval Air Station at Sand Point. The facility would not be consistent with a Citizen Group's "Lake Washington Goals and Policies", however, these goals and policies were taken into account before Seattle adopted their Seattle Master Program. The Program was reviewed and approved by the Washington State Department of Ecology. Construction of the proposed facility at Sand Point would be consistent with the Washington Coastal Zone Management Program (Appendix G). There would be no secondary land use impacts associated with the relocation of employees and their families in the surrounding area since they are already working and living in the immediate area.

Use of Lake Washington itself is also a planning concern, although not land use issue per se. Introduction of NOAA vessels into Lake Washington would not constitute a precedent, since commercial traffic currently uses the lake and larger ships have used the lake and the ship canal since 1914, particularly during the 1940's. Similarly, development of shore facilities for use by NOAA vessels would not provide a precedent for industrialization of the lake since few such uses would qualify as water-dependant research or educational uses. Nonetheless, regular use of Lake Washington by NOAA ships would be counter to the developing recreational character of the lake, which serves as an important resource for the growing population of the communities surrounding the lake.

Demography

If the NOAA facility were to locate at Sand Point, population growth, housing, and unemployment levels should not be affected since NOAA is now operating within the Seattle region.

Economic Forces

The proposed site is publicly owned; therefore, no real estate tax revenue would be lost if NOAA were to locate on the site.

Retaining NOAA in the Seattle area would ensure continued federal employment and a continued diversified employment base. Most NOAA employees and their families would continue to live in their present homes, thereby avoiding the associated costs and environmental impacts of relocation.

Utilities and Energy

The Water Service Director of the Seattle Water Department has determined that the existing system is adequate to provide NOAA's estimated domestic water and fire flows (Price, 1978).

The Seattle Engineering Department has determined that the existing sanitary interceptor is capable of handling the additional sanitary flow estimated for the proposed NOAA center, provided that the connection is made at or north of the existing United States Navy connection to the interceptor, which is approximately 725 feet south of N.E. 85th Street.

Seattle City Light officials advise that NOAA's estimated demand could be met with presently available resources.

Public Services

Area population growth would be little affected by the projected growth of the NOAA center. Increased population would be dispersed over a wide area and would not significantly affect the Seattle Police Department.

The Navy Fire Department at Sand Point would be the fire department most likely to respond to a fire at the proposed NOAA facility or the ship berthing area. The Seattle Fire Department has indicated that current response in the vicinity of the site is adequate in terms of access and response time, but may not be sufficient in terms of firefighters and equipment responding. If the NOAA center is built at this site the department may have to consider increasing the response, either by having more companies respond to calls in the area or by increasing the number of firefighters at nearby stations. If growth of apartments and condominiums in the area continues, more firefighters will need to be added at stations in the area. No fire boats are presently located east of the Chittenden locks.

Representatives of Seattle Public Schools have indicated that the amount of growth anticipated by NOAA would not have any adverse effect on the local schools. There is currently excess space in the schools, especially those in the north end. Further enrollment declines are expected over the next five years.

Transportation and Circulation

Impacts on average daily traffic levels are shown in Figure F-1C. Sand Point Way would probably be used by most of the NOAA traffic. It provides the best route to the University and is a reasonable choice for non-peak hour travel to downtown. Impact on Sand Point Way will be negligible with respect to traffic operation. The peak hour NOAA traffic will generally be opposite the existing traffic, thereby equalizing the flow to some degree. The congestion currently existing on the Evergreen Point Floating Bridge and the Montlake Bridge will not be perceptively increased by NOAA traffic. The distance from the site to these bridges will allow for dispersion onto less congested surface routes of the NOAA traffic not requiring use of the bridges to reach their destination. NOAA ship transits (fewer than 120 per year) would require increased bridge openings along Lake Washington Ship Canal, disrupting traffic across this corridor. The traffic volumes on the arterials in the vicinity of the site would be well within the vehicle capacity limits for the roadways.

The existing occasional operational problem at the north gate could be alleviated by providing additional lanes leaving the base and by modification of the timing of the traffic signal during the problem period. The disruption due to bridge openings would be minimized by avoiding transits during peak hours.

Navigational Risk

Development of the NOAA facility at Sand Point would increase navigational risks to NOAA ships and to other vessels, as discussed in Appendix A. The configuration of the canal is such that ships must request opening of the University Bridge while making a 113 degree turn under the Interstate 5 fixed bridge; if the bridge were not open when the 113 degree turn was completed the vessel would have to attempt a rapid stop. Maneuvering room at the east end of Portage Cut is limited by the presense of a shoal and manuevuring room in the cut itself is limited by its stepped bank configuration. The lack of maneuvering room could pose potential problems for conflicts with non-regulated vessels. A major concern is the very heavy recreation use of Portage Cut and Union Bay during the summer. In contrast, no impact on activities at the Laurelhurst Beach Club is expected. Wake damage at about four knots, the maximum speed informally adopted by NOAA vessels in the Lake Washington Ship Canal is minimal; wakes of smaller pleasure craft, moving at the posted speed limit of seven knots, are larger.

A variety of measures could be implemented to mitigate these hazards; these measures and their consequences are discussed in Appendix A. Two mitigative measures that are variations on the split-site alternative will be described here since they are also associated with impacts on other environmental elements. The "staging pier" alternative proposes inclusion of a single berth staging pier at Sand Point where a ship could dock temporarily to load or unload; under this alternative most waterfront activities would be located elsewhere. The "small vessels only" measure would provide docking facilities for all smaller vessels (175 feet in length or less); larger vessels would be provided with docking facilities at a separate location. In contrast to the other mitigative measures, these mitigate the navigational risks by reducing the number of transits into Lake Washington. A larger reduction would be associated with the "staging pier" alternative.

SECTION 6: NORTH HYLEBOS

EXISTING ENVIRONMENT

Geology and Landforms

Almost all of this site is periodically underwater (see Figure 2-10); most of the upland portion has been extensively altered by human activity (Walters and Kimmel, 1968). The elevation of the upland margin is about 20 feet. Much of the site is intertidal. North of Marine View Drive, which borders the site to the north, a high bluff of glacially transported material rises several hundred feet. The Hylebos Waterway forms the southern site boundary; areas adjacent to the site are not visually separated by any abrupt topographic changes. Seismic hazards will be related to the nature of the fill used and adequate compaction (see the earlier general discussion under "regional geology").



Legend

● Army Corps Sediment Sample Site

© STORET Water Quality Sampling Site

Note:
Sampling Sites CMB015 and 1are located to the west off of the map.

500 1000

Scale in Feet

Figure 2-10

North Hylebos Site - Existing Conditions

Soils and Erosion

Soil at this site consists mainly of silty sand deposited during dredging of Hylebos Waterway and by natural processes (URS/Hill, Ingman, Chase, 1973). No significant erosion is presently occurring on this site.

Climate

The regional climate description is applicable to the North Hylebos site. Winds, as measured at Meeker Junior High School, are generally out of the north-northeast and south-southeast. Temperatures, wind speed, and precipitation do not differ significantly from observations pertaining to the entire Puget Sound region.

Air Quality

The North Hylebos site lies at the edge of a very heavily industrialized area. Air quality is poorer than in most of the Puget Sound area. Existing CO background levels in this area are probably fairly high because of the proximity to major sources of CO such as highways and heavy industry; an estimate of 2.5 ppm is used. Data from a nearby monitoring station indicate that total suspended particulate levels are well below standards. Sulfur dioxide (SO_2) concentrations were below standards for 1976 but exceeded the 1-hour standard (.25 ppm) on four occasions in April, 1977.

The ships would pass through areas of generally better air quality than where the site itself is located. Therefore, the values presented are the worst associated with this alternative.

Expected trends to 1983 vary slightly from the regional trends (given in the general discussion). SO_2 levels should remain the same or increase slightly as EPA has granted a five year variance to a major industrial source in Tacoma.

Water Quality and Aquatic Biology

The North Hylebos site is located in an established harbor area near the mouth of a major river. Water quality is generally low (the site has been placed in Class B by the State of Washington). Sediments are quite organic and contaminated by many compounds. Nevertheless, significant populations of benthic organisms and fish use the site.

The site is on the Hylebos Waterway, which is located on the northeast side of the Tacoma harbor complex (see Figure 2-10). The complex itself is located on the delta formed by the Puyallup River (mean annual flow of 1800 cfs), whose channel lies one and one-half miles west of the Waterway. The Waterway, which is 3.1 miles long and averages about 0.2 miles wide, is dredged to a depth of 30 feet below MLLW. Hylebos Creek, draining an area of approximately ten square miles, empties into the upper end of the Waterway. In addition, nine industrial discharges into the Waterway are identified (Washington State Department of Natural Resources, 1972).

Available data (Table B-8) show little change in the average water quality as one moves up the Waterway, with the exception of a substantial increase in coliform levels. In contrast, maximum temperature and turbidity increases, and minimum

dissolved oxygen levels decrease, indicating that the environment in the upper waterway is more stressful than that in Commencement Bay. A previous study showed a substantial salinity gradient from the surface to the bottom (20 and 30 ppt, respectively) on a calm day in the vicinity of the Port of Tacoma site (URS Company, 1973); dissolved oxygen varied little with depth.

Chemical analyses of the sediments have been conducted by the U.S. Army Corps of Engineers. Data for six locations in the Waterway (Table B-9) indicate that the sediments withint he water have moderate levels of volatile solids, oil and grease, and sulfide, and release significant concentrations of several heavy metals in elutriate tests. This contamination is probably a result of industrial discharges.

The Puyallup River supports major runs of coho and chum salmon, and smaller numbers of chinook. Hylebos Creek is used for spawning by anadromous fish; chum and pink salmon are listed as using the Creek (Washington State Department of Fisheries, 1975) and several hundred coho and a few chinook salmon have been observed spawning in a small tributary to Hylebos (Kerwin, 1978). The Creek is also used for spawning and rearing by steelhead and sea-run cutthroat. In addition, large numbers of juvenile chum salmon have been planted in the creek by the Puyallup Indian tribe as part of an enhancement program.

The site is an intertidal area whose bottom composition is silty with some sand. A search for larger benthic organisms (URS, 1973) indicated that few such organisms exist in the area. Small numbers of clams, mussels, barnacles, and larger polychaetes were noted. Only an occasional shrimp and rock crab were observed. A more recent study of the small benthic invertebrates (Meyer & Vogel, 1978) found very large numbers of small polychaetes, oligochaetes and nematodes. Perhaps more significantly, they found large numbers of Gammarid amphipods, Harpacticoid copepods and some Cumacea. Such organisms have been shown to be an important part of the diet of juvenile salmon during their early life stage in nearshore saltwater areas. Since both Pink and Chum Salmon are known to spawn in Hylebos Creek, Meyer and Vogel concluded that the intertidal area comprising the site could be an important feeding area.

Terrestrial Biology

The major portion of the North Hylebos site is presently exposed mudflats and tidelands. Much of the area is used for log storage. Vegetation on the upland portion of the site is typical of disturbed areas, and includes grasses, thistle, lupine, vetch, and bindweed. Some songbirds use the upland margin; shorebirds, wading birds, gulls and ducks use the remaining portions of the site. See Appendix E for species list.

Natural Resources

No mineral resources occur at this site. Its importance to wildlife, especially fish, has been discussed in the sections on "aquatic biology" and "terrestrial biology".

Aesthetics

Most of the proposed site is underwater in Commencement Bay.

Although presently undeveloped, the site has been proposed for filling and industrial use and is surrounded by heavy industry and shipping activity. The Port area has been committed to industrial use for years. There is a view of Commencement Bay and Mount Rainier beyond the port area. Some homes far above the Port of Tacoma, on a steep bluff, overlook the site and adjoining industrial areas.

Archaeological and Historic Resources

Although shoreline locales were favored by Indians in this area, and archaeological materials may have been present on the site, it has been so extensively disturbed by excavation and filling that no intact resources are likely to be present. No such resources are known to exist on the site.

Noise

Noise levels near the North Hylebos site are typical of levels found in industrial areas. (See Table D-1.)

The background noise sources in the area during the daytime are the surface transportation system and industrial activities. Most of the waterfront area is dominated by commercial boat activities and light or heavy industry (e.g., grain elevators, wood processing, construction, and power plants). These industrial areas are connected by a surface transportation system of roads and railroad tracks. Residential areas are located at considerable distances from this area.

Demography

The City of Tacoma has gained population slowly over the last several years. In contrast, Pierce County (which surrounds Tacoma) has had and is expected to continue to have a steady gain of population. In 1977 Tacoma had 156,000 people while Pierce County had 471,000 people. Between 1970 and 1977 Tacoma gained only about 1,500 people; this slow growth in Tacoma is expected to continue. Pierce County is expected to add about 100,000 people between 1977 and 1985.

Like the Seattle and Everett areas, Pierce County lost population in the early 1970's because of the Boeing layoffs, the economic recession, and reduction of military personnel following the Viet Nam conflict. Subsequently, Pierce County has more than regained the lost population.

Construction of new housing in Pierce County is steady but not booming. Much of the new housing development is occurring in the Lakewood and Gig Harbor areas. A plateau on the bluff overlooking the potential NOAA sites is largely undeveloped property but planned and dedicated for future housing to accommodate as many as 15,000 people.

The unemployment rate (April, 1978) in the Tacoma area is 7.4 percent which is above the national average of 6.0 percent.

Economic Forces

The Tacoma area has a diversified employment base with manufacturing and military installations supplying many jobs. The largest manufacturing industries are forest products, metallurgical foundaries and food processing.

Land Use

Owned by the Port of Tacoma, this site is not being used at this time. The shoreline adjacent to the site is used for log rafts. Most of the proposed site is underwater and would have to be bulkheaded and filled to be of use. Adjacent properties are used for heavy industrial purposes.

The City of Tacoma has zoning jurisdiction of the site and the shoreline. The site is zoned M-2, heavy industry, which permits most uses. Tacoma has designated the shoreline S-11, Port Industrial Segment, an urban classification that allows all water-dependent and water related industrial uses, terminal shipping facilities, landfill, dredging, bulkheads, piers, and docks.

Utilities and Energy

Water service is provided by the City of Tacoma, Water Division. A 12-inch main runs along Marine View Drive.

Sewer service is provided by the City of Tacoma Sewer Utility Division, and Engineering/Construction Division. There is an existing 18-inch sanitary sewer line along Marine View Drive, and several existing storm sewer outfalls that drain to the Hylebos Waterway.

Electrical service is provided by the City of Tacoma. High voltage transmission lines presently run along Marine View Drive.

Public Services

The City of Tacoma Police Department provides police protection for the City of Tacoma, including the Port.

The Tacoma Fire Department provides fire protection services.

Enrollment in the Tacoma School District, which would serve the children of NOAA employees who relocated to Tacoma, is presently declining at the rate of about 800 students per year.

Transportation and Circulation

The site is bounded by Marine View Drive and E. 11th Street, both of which are designated as SR 509. The traffic volumes for both of these streets in the vicinity of the site are moderate for the design of the roadway, and Taylor Way traffic volumes are low. The drawbridge over the Hylebos Waterway on E. 11th Street, is a two lane facility adequate for present traffic volumes. This structure is periodically damaged by ramming by barges, requiring that all 11th Street traffic be detoured. No existing traffic operational problems are known on the streets in the area of the site. Access to Interstate 5 via Taylor Way and the Port of Tacoma Interchange is excellent. Some operational problems presently exist at that interchange. Tacoma Transit provides bus service to 11th and Marine View Drive every hour between 7 a.m. and 5 p.m.

Navigational Risk

Navigational risks at this site, discussed in detail in Appendix A, are considered briefly here. Access to the site is restricted to a 190 foot channel. The Port of Tacoma is the second largest port in Washington State and handled about 10 million tons of cargo in 1976, thus commercial traffic in considerable, with much of it directed in Hylebos

Waterway. Some recreational boating activity occurs in the waterway, but it is not heavy. The tidal range is 8.1 feet; currents near the site are low.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

A 69-acre intertidal area would be filled to provide dry land (elevation +18 feet) (See Figure 2-11). The fill would be added to the sedimentary deposits on the site; landforms would be modified to flat land similar to the surrounding areas of the port.

Soils

Approximately 800,000 cubic yards of fill material would be required to fill the 69-acre site to an elevation of +18 feet. The Port of Tacoma has indicated that dredged spoils from planned dredging projects in the Port could be a possible source of fill material. The project would result in the conversion of a natural area to a man-made environment.

Air Quality

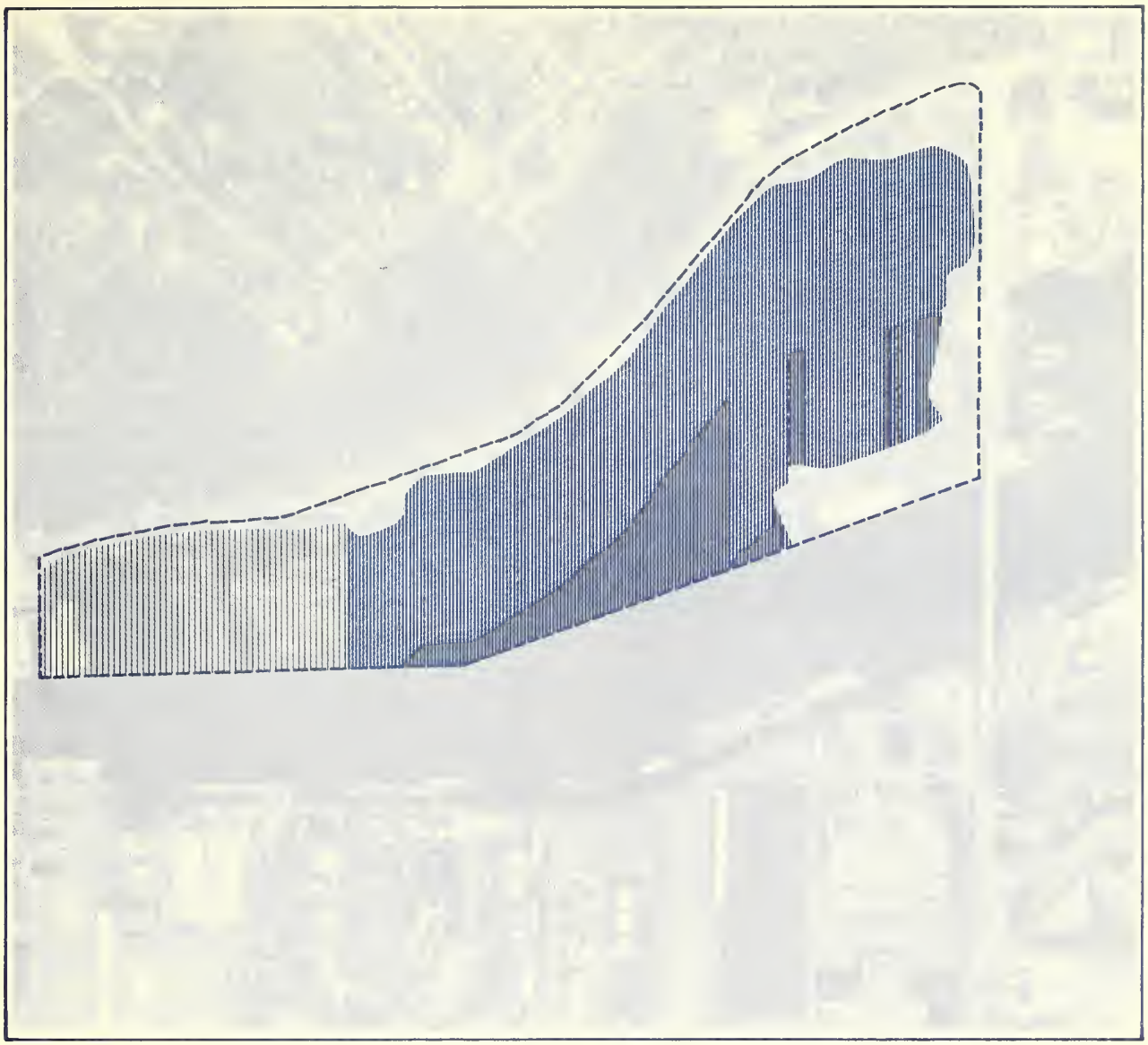
The regional and local impact on air quality would be minor given the industrial nature of the region. Dispersion calculations (see Appendix C) indicate that sulfur dioxide emissions produced by ship operations are likely to aggravate the existing problem with sulfur dioxide. The relative locations of the monitoring station, the site, and industrial sources are such that more frequent violation of standards at the monitoring station is probable. Emissions of total suspended particulates would also result; however, no exceedance of standards would occur when these emissions are added to estimated background concentrations. Traffic volume would increase, raising carbon monoxide levels near roads. Nonetheless, even under worst case conditions the expected concentrations would be well within levels established by applicable standards.

Possible mitigative measures to reduce sulfur dioxide concentrations would include use of low sulfur oil, although monitoring data indicate standards are currently exceeded even without the proposed additional emission source. If this site is chosen, it may be necessary to restrict vessels such as the SURVEYOR to departure during periods of offshore breezes.

Water Quality and Aquatic Biology

The most serious impacts would result from elimination of intertidal habitat; some construction impacts would also occur.

Because the 69 acres available at this site are almost entirely underwater, development would entail filling most of the site. Ten acres along the northern portion of the site would be deepened to develop a moorage area for the ships. About 800,000 cubic yards of fill, most of it from maintenance dredging of the harbor channels would be placed behind berms at the site. Water quality impacts upon the Hylebos Waterway would be minimal during this operation as the fill would probably be handled in solid form. Water return from the fill site would also be minimal. Dredging of the slip space at the north end of the site would suspend a considerable amount of high organic content



Legend
Dredge Area
Fill Area

500 0 500
Scale in Feet

Figure 2-11

North Hylebos Site - Impacts

bottom material. The relatively high salinity in the Waterway would promote rapid resettling of this material. Since a temporary depression of dissolved oxygen, which would adversely affect fish and benthic animals, is likely near the dredging, it could be done during the winter months when dissolved oxygen levels in the water are generally highest and fish migration is minimal.

Fifty to sixty acres of intertidal habitat would be permanently eliminated. As mentioned above, this site has been shown by the U.S. Fish and Wildlife Service to be a productive area for growth of organisms that might serve as a food source for juvenile pink and chum salmon in the early stage of saltwater transition. This is one of few intertidal areas remaining in Commencement Bay; hence it may be an important shelter area for juvenile salmon despite the industrial character of the Waterway. Prior to a firm decision to develop this site, an intensive study during the period of juvenile chum salmon out-migration should be performed to determine its importance to fish.

The change in the character of the shoreline would also reduce benthic habitat. Most of the 6,000 feet of existing shoreline, which is silty sand and slopes off very gradually, would be replaced by approximately 4,000 feet of steeply sloping, riprapped bulkheading.

During operation of the facility, stormwater runoff from the site would, at worst, be of no lower quality than that of surrounding industrialized areas. It is not expected to adversely affect the present water quality of the Hylebos Waterway. The slow currents within the Waterway would facilitate fuel spill containment; a boom system like that in operation around the present PMC berthing facilities at Lake Union should be adequate to contain the small, infrequent, dockside spills for cleanup.

Terrestial Biology

Development of the North Hylebos site would entail filling of the site, causing displacement or elimination of animal species now using the area. The shallow intertidal habitat, presently used by shorebirds and ducks, would be permanently eliminated. Because of the relatively large size of this site, landscape planting on the site would slightly increase the habitat available locally to land dwelling species tolerant of human activities. Neither of these impacts would be regionally significant.

Natural Resources

Development of the NOAA Center at this site would permanently remove the shallow intertidal habitat. No other natural resources would be affected.

Aesthetics

If built here, the NOAA facility would change the appearance of the site by replacing the log boom area with a landscaped campus-like or commercial office building complex appearance.

Archaeological and Historic Resources

No impacts are expected.

Noise

Impacts on the North Hylebos site are the same as for the Everett site, since similar land uses surround both sites.

Demography

Location of the NOAA center in Tacoma would probably result in the eventual relocation of many of the 2,000 projected employees. Many current employees would find an additional 30 mile commuting distance too far and would relocate to the Tacoma area over time; others would probably quit. Most new employees would probably locate in the vicinity. Therefore, the currently projected population growth for the area would be realized sooner than expected.

Although the local unemployment level would probably not be directly affected by the relocation of NOAA to Tacoma, the need for additional services and facilities would probably reduce unemployment.

Economic Forces

The proposed site is industrially zoned. If NOAA were to locate here, that industrial use would no longer exist. With limited industrially zoned properties available, a decision to take industrial property for this purpose should be evaluated carefully. The proposed site is publicly owned; therefore, no real estate tax revenue would be lost if NOAA were to locate on the site. If NOAA located in Tacoma, they would be the single largest employer. Establishment of the center in Tacoma would also strengthen the local economy by diversifying that city's employment base.

NOAA employees locating in the Pierce County and Tacoma areas would increase revenues as a result of increased real estate values and increased sales and business occupation taxes, as services and commodities are supplied. These economic benefits would have to be compared first to the increased costs for supplying facilities such as roads and utilities to the facility, and then to new housing areas to determine whether the project would produce a net benefit.

Land Use

The NOAA facility would be compatible with the Tacoma Shoreline Master Plan, zoning, and surrounding uses. There would be minimal secondary impacts associated with locating employees and their families in the surrounding area since there are already plans and adopted plats in Pierce County to accommodate many times the number of persons expected to be employed by the NOAA facility.

Utilities and Energy

The Superintendent of the Water Division indicates that the existing system is adequate to supply NOAA's estimated total combined fire and domestic flow requirements. No impacts are expected.

The Chief of the Sewer Utility Division has indicated that the existing sanitary sewer system is adequate to handle NOAA's projected wastewater flows. Pumps may be necessary, depending on the exact location of facilities. No impacts are expected.

The existing storm sewer flows would have to be extended if the site were filled. Since the site

borders the Waterway, a complete surface water control system could be developed during construction of the NOAA facilities on the site

Adequate power supply is available at this site according to a representative of the City of Tacoma, Public Utilities Department. No impacts are expected.

Public Services

The City of Tacoma Chief of Police has indicated that no problems are expected in providing service in the area.

The Tacoma Fire Department states that the tideflats area is one of the best protected areas in Tacoma. No problems are foreseen in terms of manpower, equipment, or response time.

Enrollment in the Tacoma School District is currently declining by approximately 800 students per year. District officials have indicated that growth from the NOAA center would temporarily offset this decline, and it would not be expected to have significant impacts on the District.

Transportation and Circulation

The NOAA generated traffic for this site would have the greatest impact on Marine View Drive and E. 11th Street. If the access point is on Marine View Drive, the NOAA impact would increase traffic volumes by 50% between the site entrance and E. 11th Street (See Figure F-1b). Freeway-bound traffic would probably seek the Port of Tacoma Interchange at Fife by either Marine View Drive and Taylor Way or E 11th Street and Taylor Way. Since the peak hour traffic that used E. 11th Street in the site area would be in the opposite direction of existing peak flow, it would help to equalize traffic flow.

Navigational Risk

Navigational risks, both to NOAA ships and to other vessels, would be high for development of this site, as discussed in detail in Appendix A.

SECTION 7: SOUTH HYLEBOS

EXISTING ENVIRONMENT

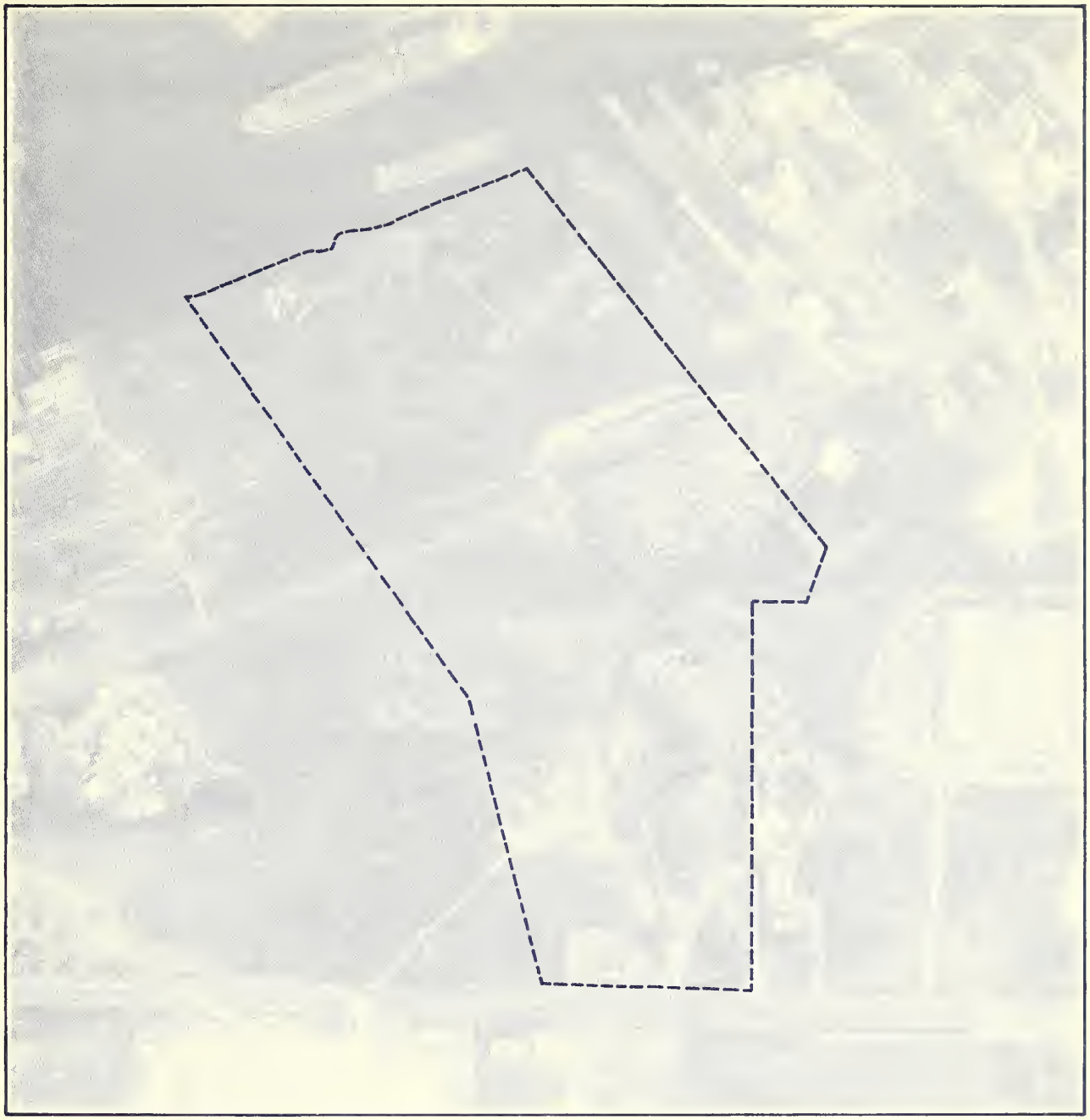
Geology and Landforms

This site consists of flat, filled land. The Hylebos Waterway forms the northern site boundary, and land of similar elevation occurs to the west, south, and east (See Figure 2-12).

The geology of this site has been extensively modified by the filling of tidal lands (underwater at high tide) to create the land. The underlying geological unit is probably recent alluvial material. Because the site is fill, seismic risks include differential settlement due to liquefaction (see general discussion in "regional geology").

Soils and Erosion

Soils at this site are man-made land, built artificially by filling with debris and dredge spoils. Erosion problems are minimal because of the level terrain.



Legend

Note:
Army Corps Sediment Sample Sites (4, 5, 6) and STORET Water Quality sampling site (CMB017) located to the east off of the map.



Figure 2-12

South Hylebos Site - Existing Conditions

Climate

The climate of this site does not differ significantly from that of the North Hylebos site, previously discussed.

Air Quality

Air quality at the Hylebos site is essentially the same as described for the North Hylebos site.

Water Quality and Aquatic Biology

The shoreline of the South Hylebos site is rip rapped and slopes steeply into the Waterway. The water quality of this site differs little from that near the North Hylebos site, located less than a half mile north. The section of the Hylebos Waterway adjacent to this site does not appear to be an important habitat for any marine life; however, some anadromous fish runs pass the site as described in the North Hylebos section.

Terrestrial Biology

The vegetation of the Hylebos site is typical of vacant fill land in the Port of Tacoma; grasses, mullen, blackberry and similar weedy species occur on portions of the site and a few small trees are present. A variety of song and shore birds use the site and its resources (See Appendix E for species list). The site is not regionally significant as a habitat for terrestrial species.

Natural Resources

This site is man-made land, built by filling with debris and dredge spoils, hence no mineral resources are present. The site is not significant for wildlife or fisheries.

Aesthetics

The proposed site is presently a deserted industrial site. Several abandoned deteriorating buildings are present. The site is surrounded by heavy industry and shipping activity; the port area has been committed to industrial use for years. A few homes far above the Port of Tacoma on a steep bluff overlook the site and the adjoining industrial area.

Archaeological and Historic Resources

Although shoreline locales were favored by Indians in this area, and archaeological materials may have been present on the site, it has been so extensively disturbed by excavation and filling that no intact resources are likely to be present. No such resources are known to exist on the site.

Noise

The regional noise setting for the South Hylebos site is the same as that described for the North Hylebos site. Noise levels on the site (Table D-1) differ little from those near the North Hylebos site.

Demography

The South Hylebos site is so close to the North Hylebos site that the discussion given under that site is completely applicable.

Economic Forces

Like demography, the economic forces affecting the South Hylebos site do not differ from those affecting the North Hylebos site.

Land Use

Presently unused, the privately owned South Hylebos site was used, until recently, for industrial purposes. The site is very close to the proposed North Hylebos site on Hylebos Waterway. Adjacent properties are used for heavy industrial purposes.

The City of Tacoma has zoning jurisdiction of the site and the shoreline. The site is zoned M-2, heavy industry, which permits most uses. Tacoma has designated the shoreline S-10, Port Industrial Segment, an urban classification that allows all water-dependent and water-related industrial uses, terminal shipping facilities, landfill, dredging, bulkheads, piers, and docks.

Utilities and Energy

The City of Tacoma Water Division provides water service to the site. Service would be provided by a 20-inch water main which runs along Taylor Way.

Sewer Service would be supplied by the City of Tacoma's Sewer Utility Division and Engineering/Construction Division. There is an existing 12-inch sanitary sewer line along Taylor Way. There is no existing storm sewer drainage on the site or on Taylor Way.

Electrical service is provided by the City of Tacoma. High voltage transmission lines run along Taylor Way.

Public Services

Existing conditions with respect to public services are identical to those described for the North Hylebos site.

Transportation and Circulation

The site is bisected by a railway line and by Taylor Way, which is a two-lane facility at the site which changes to a four-lane roadway as it nears I-5. Taylor Way connects directly to I-5 at the Port of Tacoma Interchange. Present traffic signals are adequate. Access to downtown is via E. 11th Street to the west of the site. The roads in the Port area carry relatively low traffic volumes, with the exception of E. 11th Street, which is serving moderate volumes. Some operational problems presently exist at the Port of Tacoma Interchange. Transit service to Lincoln Avenue and Taylor Way is available once an hour from 7 to 5.

Navigational Risk

Navigational risk associated with this site is somewhate greater than for the North Hylebos site. Access is somewhat restricted by the E. 11th Street Bridge, which has a history of mishaps. The channel depth varies between 26.0 and 28.3 feet; channel width decreases to 160 feet at the narrowest point, which restricts maneuvering space somewhat.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

No significant impacts on geology would result from development of the NOAA center on this site.

Soils

No long-term impacts are expected on soils at this site. Construction impacts such as temporary on-site storage of soil and rubble would be short-term and would not have significant adverse effects on soils.

Air Quality

Regional and local impacts from operation of the proposed center at the South Hylebos site do not differ from those identified for the North Hylebos site. Similarly, construction and shipping impacts are identical. Results of the carbon monoxide analyses for the South Hylebos site differ slightly from those of the North Hylebos site since the traffic would take slightly different routes to reach and exit the proposed site; however, no violation of standards would be expected, even under worst case conditions.

Water Quality and Aquatic Biology

Relatively few water-related impacts are expected to result from development of this site. Excavation of up to ten acres of the site adjacent to the Hylebos Waterway would be required to provide berthing for the ships (See Figure 2-13); excavated material could be disposed of on-site. Excavation should start at the landward side and proceed to the Waterway to minimize release of suspended material into the Waterway. Any dredging required to connect the excavated slip to the Waterway should be timed for the winter months, if possible, for reasons presented under the North Hylebos water quality impacts discussion. Impacts on water quality would be mitigated by excavation of one large slip rather than several narrow slips; this measure would minimize problems of water stagnation and entrapment of migrating fish. Piers or cement pilings could be built out into the slip to supply needed berthing. The physical character of the shoreline, bulkhead, and rip-rap, would remain the same; however, its length would be increased from 1,100 feet to 3,000 feet. The water quality impacts of small dockside fuel spills and stormwater runoff during facility operation would be the same as discussed under the North Hylebos site.

Since the site does not provide important habitat for any aquatic life, impacts to the aquatic biology would be minimal.

Terrestrial Biology

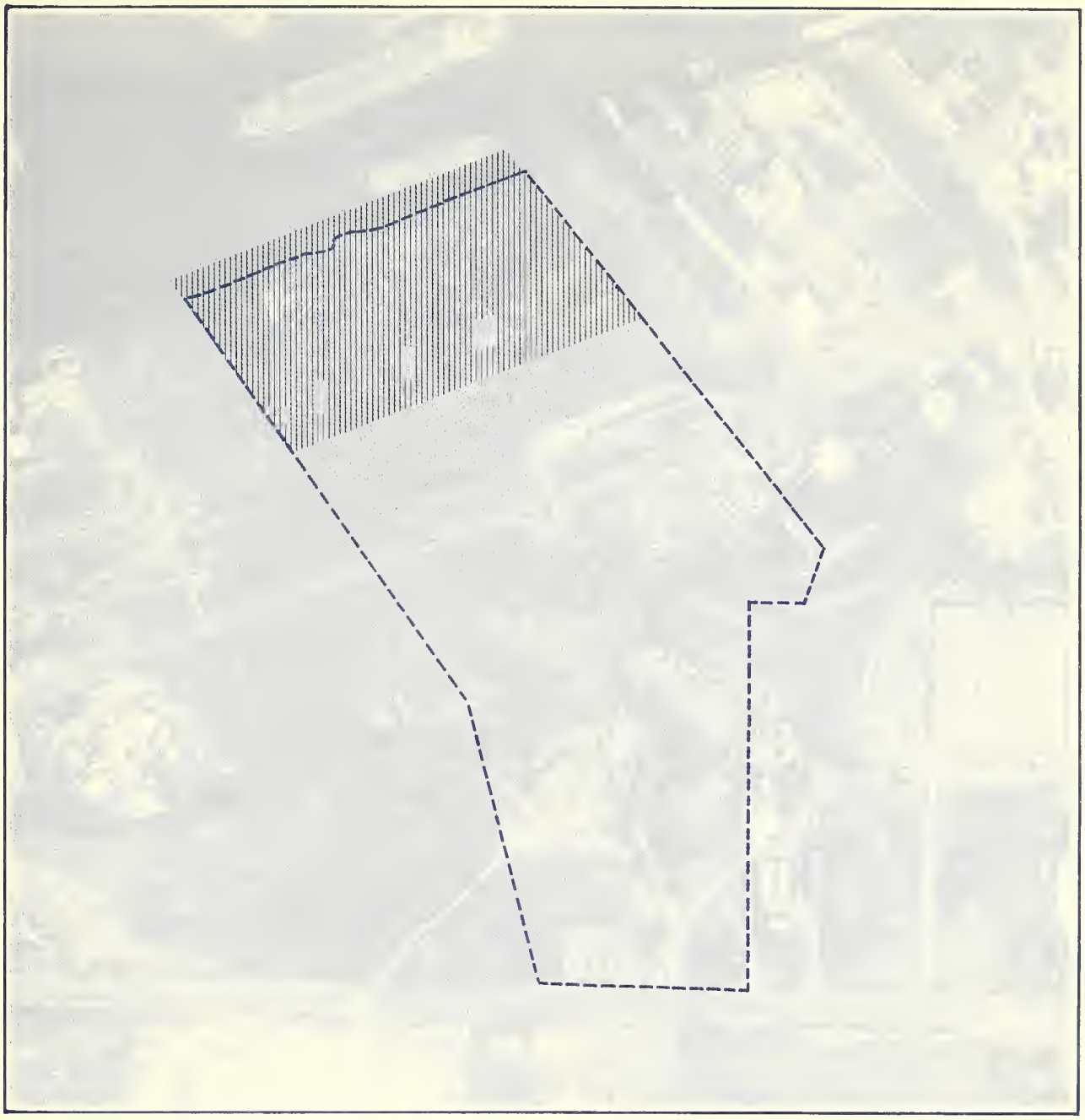
The vegetation on the site would be disrupted during construction of the proposed facility, and wildlife using the site would be displaced or eliminated. Long-term impacts would be positive; introduction of more vegetation would result in higher biological productivity for some human tolerant species. Neither effect would be regionally significant.

Natural Resources

No natural resources would be affected by development of the South Hylebos site.

Aesthetics

If built here, the NOAA facility would replace the deteriorating, unused industrial buildings on the



Legend | Dredge Area

Figure 2-13

South Hylebos Site — Impacts

site with a landscaped campus-like commercial office building complex appearance.

Archeological and Historic Resources

No resources are present in this filled area; therefore, no impacts would occur.

Noise

Noise impacts for the South Hylebos site do not differ from those discussed for the Everett site, since land use is similar for both sites.

Demography

Impacts on population, housing and unemployment would be the same as for the North Hylebos site.

Economic Forces

Economic impacts for the South Hylebos site differ from those for the North Hylebos site only in that the proposed site is privately owned. Therefore, a change to federal ownership would result in a loss of real estate tax revenues to local jurisdictions. NOAA would become the largest employer in Tacoma.

Land Use

Land use impacts are the same as discussed for the North Hylebos site.

Utilities and Energy

The superintendent of the Water Division indicates that the existing system is adequate to supply NOAA's estimated total combined fire and domestic flow requirements. No impacts are anticipated.

The Chief of the Sewer Utility Division indicates that the existing system is adequate to handle NOAA's projected wastewater flows. Pumps may be necessary, depending on the exact location of facilities. No impacts are anticipated. Storm sewer drainage could be developed during site preparation. Lines could be extended to serve Taylor Way and that part of the site west of Taylor Way. Discharge would be to the Hylebos Waterway.

According to a representative of the City of Tacoma Public Utilities Department, adequate power supply is available at this site. No impacts are anticipated.

Public Services

Impacts on public services are identical to those discussed for the North Hylebos site.

Transportation and Circulation

The traffic generated by development of the NOAA facility at this site would increase the existing traffic volumes on Taylor Way by about 50 percent (See Figure F-1b). NOAA traffic using E. 11th is expected to only be a small percen-

tage of the existing traffic volumes. The major route would probably be Taylor Way. There is adequate existing capacity to serve the projected traffic volumes on the roadways in the site vicinity. The road network in the vicinity of the interchange is in need of redesign to operate more efficiently. Since the interchange is some distance from the proposed site and the employees will be leaving at staggered times, the impact of NOAA on the interchange operation is expected to be insignificant.

Navigational Risk

The estimated accident rate at the South Hylebos site would be somewhat higher than at North Hylebos as a result of an increased risk of ramming, and because of maneuvering constraints.

SECTION 8: MANCHESTER

EXISTING ENVIRONMENT

Geology and Landforms

The Manchester site is located on Clam Bay, which lies between Middle Point and Orchard Point (See Figure 2-14). The land slopes gently down to the beach; terrain in the vicinity is rolling to nearly level. The geological unit covering the site (Garling, et al, 1965) is glacial till deposited by the Vashon glaciation.

The only geological hazard present at this site is the earthquake hazard common to all the sites and discussed in detail under the "regional geology" section. The site does lie about 1.5 miles south of a known fault, the Seattle-Bremerton fault. Earthquake damage on this site would be limited to effects of strong ground motion, and depending on the nature of the off-shore sediments, differential settling of the berthing facilities due to liquefaction.

Soils and Erosion

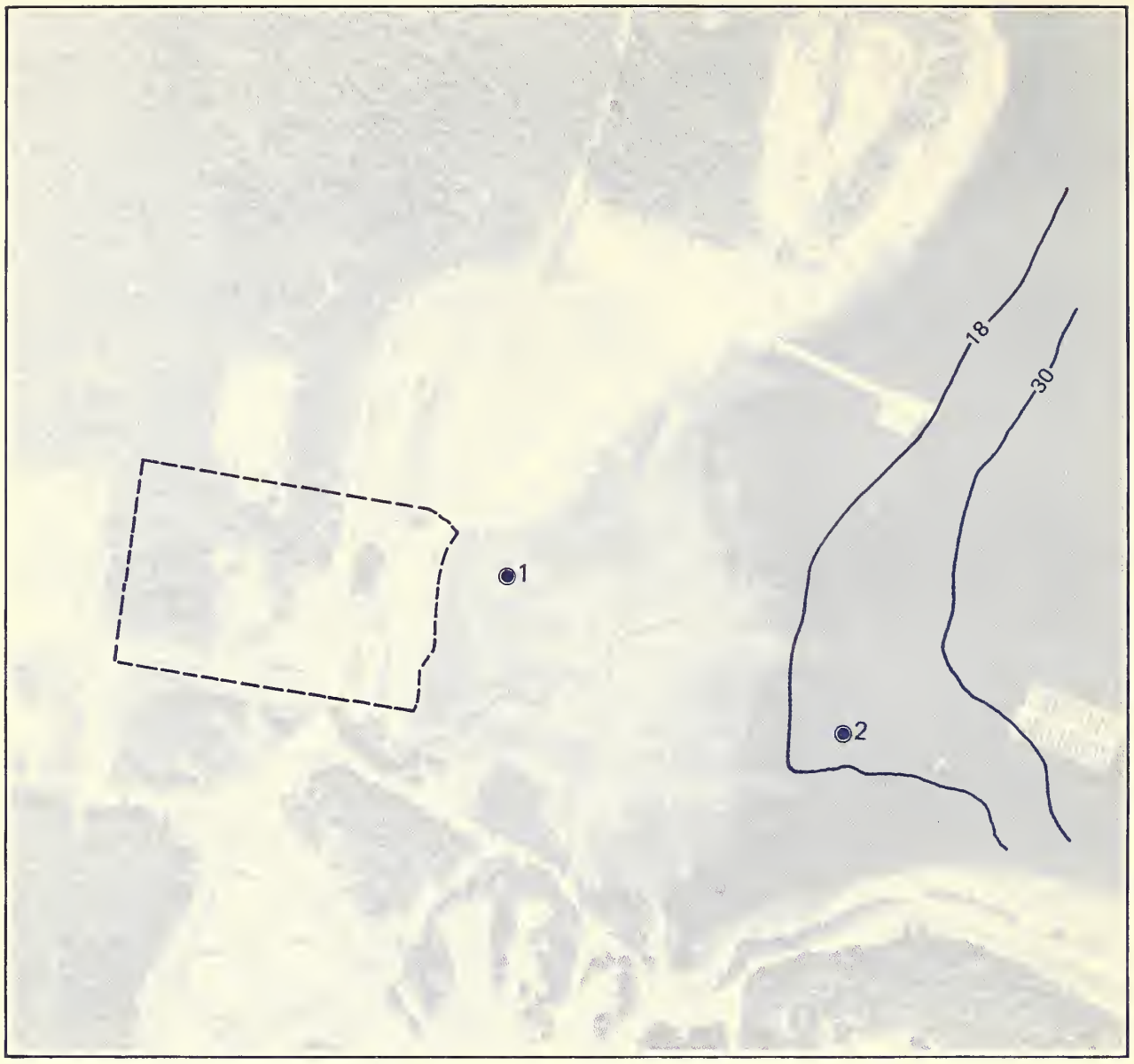
The soils on the site are principally loams and sandy loam (undifferentiated alluvial soils, alderwood loam, and a small area of Edmonds loamy sand). Erosion hazards on these soils are slight. Surface permeability is sufficient to keep the surface layer well drained; however, the underlying till is a barrier to further water movement.

Climate

The climate of the Manchester site differs from that described in the general discussion only in that temperatures would be slightly more moderate than at inland locations.

Air Quality

This site lies in an area devoid of major sources of air pollution; therefore, no air quality problems exist near the Manchester site. The fuel depot adjacent to the site would be a source of non-methane hydrocarbon; however, these would not affect local air quality. Data from the Bremerton station indicate that total suspended particulate levels are quite low. Carbon



Legend
- Sediment Sampling Site
- Soundings in feet

500 1000
Scale in Feet

Figure 2-14
Manchester Site - Existing Conditions

monoxide levels should also be very low, given the absence of local traffic sources; 1 ppm has been used as an estimate. Sulfur dioxide levels on the site should be lower than those at the nearest monitoring station where levels were well below standards.

Water Quality and Aquatic Biology

The Manchester site is located in a shallow bay with excellent water quality, good circulation, and clean sediments. A healthy benthic community is present. Aquaculture projects are located in the bay, which is also an important habitat for naturally occurring fish.

Clam Bay, the location of the Manchester site, is a shallow embayment on the east side of Rich Passage. At low tide up to 300 yards of intertidal area are exposed; the bottom does not drop off rapidly until Rich Passage is reached (Figure 2-14). An Environmental Protection Agency owned pier extends 700 feet out into the north end of the bay.

Anchored in the outer portion of Clam Bay (see Figure 2-14) is a large salmon rearing facility, which raises several million coho and chinook salmon each year. The salmon, hatched and initially grown in freshwater ponds on Bainbridge Island, are transferred to the saltwater rearing pens at Clam Bay. By using a controlled environment and intensive feeding, the operation can produce a marketable fish within a year of hatching.

The location of the site, adjacent to Rich Passage (maximum tidal currents of about 2 knots) and near the open waters of Puget Sound, probably ensure high water quality. Temperatures near the shore of the Bay during the summer are probably somewhat higher than in the open waters. The only discharges to the Bay are return waters from the Marine Fisheries Lab and food debris from the salmon rearing operation.

Sediment analyses were performed on two samples taken offshore from the site. The results, shown in Table B-10, indicate an uncontaminated sediment.

In mid-May a series of transects along the bottom offshore of the site were observed by divers. The bottom is composed of silty sand nearshore and becomes sandy further offshore. No rocky areas were seen. A very dense bed of eelgrass that supports numerous rock crab was observed in the south-central portion of the bay in 20 to 30 feet of water. A moon snail, a few sea pens, some sole, and one true cod were also noted. Some worms were noted in the sediments but the epibenthic fauna are generally sparse. Information provided by Mahnken (1978) indicates that polychaetes are the most numerous benthic macroinvertebrates present; less numbers of lamellibranchs, ostracods, arthropods, and gastropods are also present. Some subtidal clam holes were seen and moderate concentrations of hardshell clams are reported in the area (Westly, 1978). Coho salmon are reported to spawn in Beaver Creek (Washington State Department of Fisheries, 1975). Major coho and chum runs from the East Kitsap peninsula pass through this area as adults and the area is important for rearing and passage of juveniles. Chinook salmon are also present. The adjacent state park is believed to have significant shellfish stocks available for public use.

The Washington Marine Atlas (1972) lists Clam Bay as a popular recreational anchorage and indicates that

the area offshore of Manchester is commercially fished for herring. Rich Passage is also a popular salmon fishing area.

Terrestrial Biology

The federally owned lands at the Manchester site consist mainly of unmaintained grasses, weedy species typical of disturbed areas, and some small trees, notably willows. The adjacent state park land provides a biologically more diverse habitat -- a transitional maple-alder community with a well-developed understory. Birds seen in the open grassy/shrubby habitat of the site include robins, bushtits, killdeer, and hummingbirds, other birds that favor this habitat type probably also use the site. Mammals likely to be found in the site include skunks, rabbits, raccoons, oppossum, moles and shrews. See Appendix E for species lists. The adjacent eelgrass beds are important waterfowl areas, particularly for black brant.

Natural Resources

Natural resources of the Manchester site are limited to the land and soil. The soils on the site are poor sources of both sand and gravel. The land is not presently being used for agriculture. Although some of the soils on the site could be used for growing crops or pasture, the available area would be too small for efficient farming.

Aesthetics

Most of this site, surplused by the Navy a few years ago, is undeveloped and covered with natural vegetation and trees. From the lowbank waterfront one looks onto Puget Sound, and Bainbridge and Blake Islands. With the exception of some deteriorating concrete structures on the site, the site and the waterfront are natural. The surrounding area includes a Navy fuel depot, a developing Environmental Protection Agency research station, a future state park (presently undeveloped woodland), and rural farm lands.

Archaeological and Historic Resources

The site is located in historic district that is listed on the National Historic Register. An archaeologic site is located in the area and it is possible that archaeologic materials are present on the site.

Noise

The noise levels found at the site are typical of those found in rural areas and are well within the State of Washington regulations. (See Table D-1.) Except for private motor boats, ferries, and other commercial ship activities from Manchester and Port Orchard, significant noise sources seem to be absent near the site. Present daytime noise levels near the site are dominated by bird calls and animal noises, while peak-noise levels are caused by distant motor boats or traffic on Beach Drive.

Demography

The Manchester site is located in Kitsap County, which has been undergoing dramatic population increases since the announcement that the Trident Submarine Base was to be located there. It is estimated that the base

will bring an additional 30,000-40,000 people. Kitsap County had an estimated 126,300 people in 1977, but is expected to have at least 175,000 by 1985 (a 40 percent increase in eight years).

Because of induced growth pressures, Kitsap County will continue to experience a substantial shortage of housing. To avoid "sprawl" developments, Kitsap County has adopted "urban concentrations" land use policies that identify areas for development with utility connections and areas for non-development. Much of the area surrounding the Manchester site is identified for little or no development (minimum of 2 acres per housing unit, a density not efficiently served by public utilities).

The Kitsap County region has an unemployment rate (April, 1978) of 5.7 percent, a level which is below the national rate of 6.0 percent.

Economic Forces

The economy of Kitsap County is heavily dependent on federal employment. Federal employees now exceed 15,900; when the Trident facility is operational, an additional 8,000 federal jobs will be generated. The lack of private industry contributes to a poor employment base with minimal diversity. Over 28 percent of the land in Kitsap County is federally owned. Revenues from business, occupation and real estate taxes are reduced by the federal presence, since federal facilities are exempt from such taxes.

Land Use

The Manchester site is federally owned property, presently used by NOAA's National Marine Fisheries Service as a research station. This site, an adjacent 17.5 acre parcel that the Environmental Protection Agency is using as a research station, and a 100-acre park site that was given to Washington State, were previously under Navy jurisdiction. The Navy has retained the bordering property for their fuel storage operations. Private lands surrounding the government properties are generally undeveloped and rural in character. Farms and homes with acreage predominate.

Kitsap County has jurisdiction over the surrounding land use and shoreline. The site itself is designated as "public use", which means that it is under federal and state jurisdiction and outside the zoning authority of Kitsap County. The surrounding private lands are designated as "rural", which permits a housing density no greater than one unit per 2-1/2 acres.

Nevertheless, Kitsap County has designated the shoreline adjacent to the site as "Conservancy". This designation allows measures such as bulkheads, breakwaters, dredging, and jetties as conditional uses.

Utilities and Energy

Water service is provided by the Manchester Water District. Presently, there is no service to the site or to the adjacent state park or EPA property.

Sewer service is provided by the Kitsap County Department of Public Works. Sewer lines are presently being installed to the EPA labs adjacent to the site. No sewage handling facilities are currently on the site itself.

Electrical power is supplied by Puget Sound Power and Light. Both single and three phase power are available at the site.

Public Services

Police protection is provided by the Kitsap County Sheriff's Department, which is presently so understaffed that they cannot provide adequate service. Continued growth in the County is seriously impacting the Department and no relief is in sight.

Fire protection is provided by Fire District No. 7, which has adequate levels of man-power and equipment.

Schools in the South Kitsap Public School District are presently seriously over capacity, and are being filled faster than new ones can be constructed. Two new schools are due to open within the next year and will be crowded as soon as they open.

Transportation and Circulation

Access to the site from SR 160 is provided by Colchester Road and Beach Drive, which are two-lane roads with a fair alignment. The road passes through farms and residential areas for most of the distance. Traffic volumes are very low on all routes in the site area. SR 160 is also a two-lane road with low traffic volumes. Most of the traffic on Colchester Road is going to or coming from the west via SR 160.

Navigational Risks

The site, which is at the beginning of Rich Passage, has open access to Puget Sound and does not present any special problem in its approach. Tidal range is 8.0 feet. Ebbtide currents past the site through Rich Passage are among the heaviest in the Puget Sound area. Rich Passage is regularly used by the Seattle-Bremerton Ferry and by naval vessels from the Bremerton Naval Shipyard. Recreational boating activity in the vicinity is low. For more information, see Appendix A.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

Impacts on geology and landforms of this site would be limited to necessary excavation for buildings and roads.

Soils

Development of this site would require use of most of the area. Some soil improvement for landscaping would occur. Little erosion would be expected during clearing and excavation; erosion at this time could be mitigated by use of appropriate erosion control measures.

Air Quality

Effects on regional and local air quality would be minor but noticeable since existing sources are so sparse. Operational air quality impacts would be slight. Sulfur dioxide and total suspended particulate levels would be increased by ship operations (See Appendix C); however, no exceedance of standards would result when these emissions are added to estimated background concentrations. Traffic volume

would increase, raising the carbon monoxide levels near roads (see Appendix C). Nonetheless, even under worst case conditions, the expected concentration would be well within levels established by applicable standards.

Water Quality and Aquatic Biology

Development of the proposed facility at Manchester would have minor impacts on water quality; effects on aquatic plants and animals would be more significant. This site is poorly placed with respect to the deeper, navigable water of Rich Passage; therefore, development of berthing facilities would probably require a combination of a long pier with considerable dredging (see Figure 2-15). The two acre staging area would be set back from the shore at the head of the pier. Thus, the shoreline would remain unchanged. Construction in the intertidal area and the shallows immediately beyond would be limited to the driving of cement pilings for the pier; only minor impacts (destruction of sessile organisms and local increases in turbidity) would be likely.

Further from the shore, however, extensive dredging might be required. Depending upon the length of the dock, the area dredged could adversely affect the area, which supports a relatively diverse population of marine life. The extent of the impact would depend on the area affected; however, dredging would reduce the population of hardshell clams in Clam Bay, eliminate a portion of the dense eelgrass bed located in the south-central portion of the Bay, and probably reduce crab populations in the affected area. Benthic invertebrate populations in the disturbed areas would probably recover within several years, but population density might be lower because of the increase in water depth. The tidal currents in the Bay, although relatively weak, could carry the turbidity stirred up by the dredging operation for a considerable distance. To avoid adverse impacts on the nearby Domsea Salmon Rearing Farm, a silt screen should be erected around the area of dredging to minimize movement of sediment into the Farm's rearing pens. Because the sediment is relatively low in organics, oil and grease, and released only low levels of the heavy metals tested, open water disposal of the dredge spoils might be possible.

Long-term operation of the facility would not significantly affect water quality within the bay. Small dockside fuel spills could be contained for cleanup by use of a floating boom. Because of the moderate current, a more substantial boom than that currently in use on Union Bay would probably be needed. Stormwater runoff from the facility might affect nearshore waters; increased coliform levels are particularly likely. Such effects, however, would be short-term in nature as tidal circulation from Rich Passage constantly exchanges water with the Bay.

The pier would provide a substrate for attached marine animals and algae, however, although the food and shelter offered by the pier would attract fish, this would probably not offset the loss of eelgrass bed habitat. Furthermore,the Domsea salmon pens may be incompatible with the navigational requirements of the ships approaching and leaving the pier. Hence, relocation of the Domsea operation might be necessary. Such a move, in addition to placing an economic hardship on Domsea, might necessitate costly



Legend
Dredge Area
Soundings in feet

500 1000
Scale in Feet

Figure 2-15
Manchester Site - Impacts

revisions in established fish management procedures.

Finally, although significant long-term changes in the water quality of Clam Bay are not expected, levels of toxicants associated with ship operations might increase slightly. For example, low level releases of hydrocarbons and of organo-tin compounds from anti-fouling paints on hulls are likely. Although the concentrations expected are so low that no adverse environmental effects would occur, the laboratories on the site (National Marine Fisheries Service and EPA) might have to move their seawater intakes into deeper water to avoid possible interference with their testing procedures.

Terrestrial Biology

Development of the proposed facility at Manchester would require dredging that would reduce the size of eelgrass beds near the site. Such a reduction would reduce waterfowl populations, especially black brant. On-site impacts would be much less significant although the development would remove existing vegetative cover and replace it with buildings, parking lots and landscaping plantings. Disruption of the existing habitat would result in the destruction or displacement of wildlife found at the site. Although landscaping incorporated into the final design plan would mitigate the loss of vegetation to some extent, the amount of landscaping provided on a site of this size would be so small that it would have little value to wildlife. Loss of the existing vegetation and associated wildlife would not be significant on a regional scale.

Natural Resources

Mineral resources on the site would not be significantly affected by development of the proposed facility at this site. Effects on the fish and shellfish, especially on the Domsea Salmon Farm, may be more significant; these impacts are discussed under "water quality and aquatic biology."

Aesthetics

One of NOAA's agencies, the National Marine Fisheries Service, is developing a research station on the site. Due to the restrictions the small site places on the facility, if the proposed consolidated NOAA facility were built here, it would transform the minimally developed site containing large natural areas, to one which would support concentrated development, thus leaving few natural areas. A dock structure would change the appearance of the shoreline. Surrounding public properties buffer the site from view by land, but the facility would be visible from the water.

Archaeological and Historic Resources

Because development of this site would be a federal action involving a historic preservation district, a federally prescribed set of procedures (106 hearing) would be required before the facility could be built. These procedures would determine whether any cultural resources would be affected and what measures should be taken.

Noise

The only nearby area that may be adversely impacted by construction

noise is north of the site where scattered residential dwellings occur. Distance attenuation of noise and the intervening terrain should ensure that only minor noise impacts would occur in this area during most of the construction period. Pile driving activities, however, could cause a higher level and added impact. Depending on the dock configuration, vessels might cause a minor noise impact to isolated residents north of the site. Noise levels would be within established limits. The increased traffic volumes (peak hour increases ranging from 608 percent on Beach Drive and 64 to 200 percent on Washington State Route) indicate a considerable deterioration in the noise environment (see Appendix D). Although noise levels would be greater, state and federal regulations would not be exceeded.

Demography

If the NOAA facility were to locate at the Manchester site the projected growth rate would be far surpassed. The presence of an additional 2,000 employees and their families would not only intensify an existing housing shortage, the relatively remote location of the site would place development pressures on an area that Kitsap County Planners would prefer to retain as semi-rural in character. Since commuting would be impractical,it is likely that most of the NOAA employees would relocate to Kitsap County as soon as possible. This immediate necessity for most employees to live closer to the facility would heighten the problems associated with the existing housing shortages. The demographic impacts could be mitigated by the provision of federal impact funds to subsidize Kitsap County; application for such funds could be made.

The local unemployment level would probably not be directly affected; the need for provision of additional services and facilities would probably generate additional employment opportunities.

Economic Forces

The proposed site is federally owned; therefore, no additional real estate tax revenue would be lost if NOAA were to locate on the site.

As NOAA employees would locate in the Pierce County and Tacoma areas, increased revenues would result from increased real estate values and increased sales and business and occupation taxes, as services and commodities are supplied. These benefits would have to be compared to the increased costs (for supplying facilities such as roads and utilities to the facility and to new housing areas) to determine the net benefit.

NOAA employment in Kitsap County would increase the dependence of the local economy on federal employment.

Land Use

Location of the NOAA facility at Manchester would not conflict directly with zoning. As a conditional use, the proposed development would be consistent with the "conservancy" shoreline designation. Kitsap County has no jurisdiction over the land use of the publicly owned site, therefore, any federal facility could be built there. The surrounding rural and semi-rural areas would be

affected by required support facilities such as additional housing, facilities, and services to accommodate the new population associated with the facility. This secondary impact could be mitigated by the concentration of future development rather than allowing it to sprawl.

Utilities and Energy

Officials of the Manchester Water District have stated that NOAA's estimated domestic water demand could be provided by drilling additional wells, but fire flows could not be provided.

The superintendent of the Department of Public Works has indicated that development of the NOAA center at this site would require approximately 7,000 feet of force main and a new pumping station. Also, there is doubt that the existing treatment plant is capable of handling additional flows of the size predicted.

Representatives of Puget Power have stated that they would not anticipate any problems in supplying power to meet NOAA's demands at this site.

Public Services

Officials of the Kitsap County Sheriff's Department have indicated that the estimated influx of NOAA employees to the area would aggravate the difficulty that the Department is presently experiencing in providing adequate service to the growing population.

The Chief of Fire District No. 7 has indicated that adequate protection could be provided by the existing levels in manpower and equipment at the 2 stations presently in the vicinity of the site. No impacts are anticipated.

Because schools in the South Kitsap Public School District are seriously over capacity at present, and are being filled faster than new ones can be constructed, adding the number of students estimated in the South Kitsap area would create an extremely serious situation.

Transportation and Circulation

Development of the NOAA facility at this site would greatly affect the existing traffic volumes, as shown in Figure F-1b. The NOAA traffic north of Manchester would be about twice the existing volume. Current traffic volumes on Colchester Road is about equal to the expected NOAA traffic, thus, when NOAA's expected traffic volumes are added to current volumes it would be expected that traffic would double on Colchester Road and triple on Beach Drive. The resulting volumes, however, are well within the capacity capabilities of the existing roadways, and the additional traffic is not expected to adversely affect the State Highway operation. In contrast, the impact on the ferry system would be significant. Although NOAA-related peak hour traffic would generally be opposite the existing peak hour commuter flow, the limited vehicle capacity of the ferries and the boat scheduling would probably generate overloads on certain runs. The Southworth/ Fauntleroy run is the most logical for NOAA employees living in the Seattle area or traveling to the University from the site. The Washington State Ferry System indicates that the two ferry runs made during each of the two peak hours could handle only about 50 additional vehicles. The additional peak hour passenger capacity is about 700 people.

A dedicated effort to create either car-pools or a van-pool would

be necessary to relieve the anticipated ferry problem. A suitable site in the Fauntleroy area may be necessary for a Park-and-Ride type parking lot. As employees relocate to the Kitsap Peninsula the impact will lessen, but need for students and scientists to get to and from the University will not cease.

Navigational Risk

Navigational risk would be low, although a marked channel and additional navigational aids would be required. Such mitigative measures would minimize any problems with recreational boating or ferries.

SECTION 9: LAKE UNION

The two Lake Union split-site alternatives, the present Pacific Marine Center (PMC) site and the adjacent private "drydock" site, will be discussed together since they share a common environment (see Figures 2-16 and 2-17). Differences between the two sites will be noted as appropriate.

EXISTING ENVIRONMENT

Geology and Landforms

These relatively level sites lie on the eastern shore of Lake Union at an elevation of about 25 feet. To the east, the elevation rises sharply for about 325 feet, then slopes more slowly to a maximum elevation of approximately 450 feet at Volunteer Park. Elevations north of the site rise more gently to the east, then drop down again to Portage Bay.

A clay deposited during the Vashon glaciation is the geological deposit exposed at these sites (Liesch, et al, 1963). Geologic hazards on this site are limited to the regional seismicity discussed under "regional geology".

Soils and Erosion

Most of each site is paved; soils on the sites have been extensively modified by filling and excavation. Little erosion hazard is present because the terrain is level and little soil is exposed.

Climate

Climate at Lake Union is not significantly different from that described for the sites along Lake Washington (Kenmore and Sand Point). Winds measured at the Food Circus Station, which is close to the site, show a pronounced south-southwest component; however, at the sites, winds are complicated by the presence of the lake and channeling through the Lake Washington Ship Canal. While the predominant wind direction is south-southwest, there is also a northerly flow from winds coming off the lake, especially during storms.

Air Quality

The Lake Union site lie within an area of dense, light industry along the shoreline; therefore, air quality at these sites is worse than that of the region as a whole. Carbon monoxide (CO) levels are probably relatively high; 2.5 ppm has been assumed as a background CO level based on the site's proximity to major



Legend
● Sediment Sampling Site

500 1000
Scale in Feet

Figure 2-16

Lake Union North Site (PMC) - Existing Conditions



Figure 2-17

Lake Union North Site (PMC) - Impacts

sources such as Interstate 5. Total suspended particulate levels (measured at the closest monitoring station) are within applicable standards; however, the maximum 24-hour value in 1976 was little lower than the state and local 24-hour standard. No sulfur dioxide standard was exceeded at that station during 1976 and 1977; levels at the site were probably also within standards.

Ships that are berthed at Lake Union must travel through the Lake Washington Ship Canal which has slightly poorer air quality than the Lake Union site. However, the major effect of the ships emissions will occur at the berth when the machinery is operating prior to departure. NOAA has been cited five times from 1969 to present for violation of smoke emission standards by the Class I vessels; on the most recent occasion, a civil penalty was assessed (Busby, 1978).

Water Quality and Aquatic Biology

The NOAA ships are presently berthed in Lake Union, where the water is quite deep. Circulation in Lake Union varies with several factors. Very low oxygen concentrations occur in the deeper waters in late summer; intrusion of brackish water also occurs in summer. Anadromous fish runs pass the site and benthic invertebrates are present adjacent to the site. Sediments are relatively clean.

Both Lake Union sites are used extensively for ship berthing (see Figure 2-16) and are deeper than 30 feet, except close to the shoreline. The shoreline along the PMC is bulkheaded. The shore along the drydock facility is somewhat less altered, with grass and trees growing to the water's edge.

Circulation is influenced by inflow from Lake Washington, by wind, and the number of lockages. Dye studies by Driggers (1964) indicated that water movement at the 40 foot depth was southerly, down the long axis of the lake. Another study (Loyton, 1975) indicated that water may flow back to Lake Washington during periods of very low river runoff.

Water quality varies seasonally in Lake Union. The lake becomes stratified in the spring when a stable upper layer of warmer water is formed. The oxygen content of the bottom waters decreases to very low levels during the summer; by August 1974 the concentrations had dipped below 2 mg/l a level poorly tolerated by most fish (Tomlinson, et al, 1977). Higher oxygen levels are restored when surface waters cool in the fall, allowing the lake to mix completely. Penetration of brackish water from the area around the Government Locks (which separate the saline water of Puget Sound from freshwater) four miles to the west was noted along the bottom from August to November.

Dockside oil spills at the Pacific Marine Center have been infrequent (see Table 2-1), have been contained within the oil boom, and have all been cleaned up within six hours (Schmidt, 1977). Except for one incident, all spills have been quite small. Other activities at the PMC are described in Appendix H.

Benthic macrofauna were found adjacent to the sites. Worms (oligochaetes), mollusks (pelecypods and snails) and insect larvae (chironomids) were abundant in the shallow area near the Seattle City Light power plant (Shepard, 1974). Abundant crayfish have also been noted in that area.

TABLE 2-1

Petroleum Product Spills at the Pacific Marine Center

Year	Number	Estimated Gallons
1973	5	10
1974	0	0
1975	3	300
1976	2	50
1977	0	0

Aquatic macrophytes are not present at either site because the water is too deep. Few aquatic plants are found in Lake Union (METRO, 1977).

Resident fish are found in Lake Union; anadromous fish only pass through during migration. Resident fish found in the lake include yellow perch, peamouth and northern squawfish, prickly sculpins, and most resident fish found in Lake Washington. Salmon species known to enter Lake Washington must pass through Lake Union; these include chinook, chum and sockeye salmon, steelhead and cutthroat.

The results of chemical analyses performed on sediments taken at the site as shown in Table B-11. The sediments appear to be relatively uncontaminated with the exception of high copper levels.

Terrestrial Biology

The Lake Union site where the Pacific Marine Center is presently located has virtually no vegetation or notable terrestrial wildlife. The terrestrial portion of the private Lake Union site, located adjacent to the PMC site, is not completely paved and thus includes some vegetation which is of little value as habitat. (See Appendix E for species list.) Adjacent areas include East Lynn Park, residential areas, and marine-oriented industrial uses; the park and residential areas have more vegetation and are more suitable as habitat.

Natural Resources

No mineral resources are present on these sites. The land is not a potential agricultural area.

Aesthetics

One of these sites (PMC) has been used for several years to moor the NOAA fleet. The adjacent private site has been a ship repair (drydock) facility for many years. Some of the buildings are aged and appear to be unused and deteriorating. The surrounding area is used by industry, commercial interests such as restaurants and business offices, and a community of house boats.

Archaeological and Historic Resources

Although shoreline locales were favored by Indians in this area, and archaeological materials may have been present on the site, it has been so extensively disturbed by

excavation and filling that no intact resources are likely to be present. No such resources are known to exist on the site.

Noise

Noise levels near the Lake Union sites are typical of these along commercial street arteries and in industrial areas; daytime noise levels are suitable for industrial use but unacceptable for most residential areas. (See Table D-1.) The dominant source of noise was automobile traffic on Fairview Avenue East.

Demography

The demographic, housing information, and employment data identified for Sand Point applies to these sites as well since they are both within the City of Seattle.

Economic Forces

The economic forces that affect the Lake Union site are common to all sites in the Seattle-King County area. These factors are discussed in connection with the Sand Point site.

Land Use

The two Lake Union sites separated by a City of Seattle waterway. NOAA presently moors their ships at one of the two sites, the other site is used as a ship repair facility. North of the present NOAA ship dock facility is a community of house boats. These sites are surrounded by industry, commercial offices, restaurants, and residential areas. This mix of land uses around Lake Union is exactly what the City of Seattle seeks to maintain.

The City of Seattle has zoning jurisdiction of the sites and the shoreline. Both sites are zoned "M", manufacturing, which allows the ship moorage and ship repair common to both sites. Seattle has designated the shoreline as US/LU, "Urban-Stable/ Lake Union", a designation that permits industry, shipping facilities, piers, docks, ship repair, dredging, pilings, bulkheads, and the like.

Utilities and Energy

Water service is provided at the Lake Union site by the Seattle Water Department. Fairview Avenue East contains an 8-inch water main from E. Galer Street north to a dead end at about 70 feet south of E. Howe Street. From E. Newton Street it continues north as a 12-inch water main. Water pressure is approximately 126 psi (static).

Sewer service is provided by the City of Seattle, and by a privately owned and maintained sewage lift station which connects to the City's facilities on Fairview Avenue E. All storm drains in the vicinity of the site are privately owned and maintained.

Power is provided by Seattle City Light.

Public Services

All public services are the same as for Sand Point.

Transportation and Circulation

Direct access to the site is provided by Fairview Avenue, which is generally wide enough for two vehicles, although travel lanes are not marked. The prevailing parking

practice is perpendicular to the road; development along the street is industrial and waterfront related. A portion of the NOAA activity is now located at this site and is reflected in the existing traffic. Access to the south and downtown from the site is reasonably easy via Fairview Avenue North. Traffic desiring to go north or east, such as to the University, must seek Eastlake Avenue by means of several streets connecting Fairview Avenue to Eastlake Avenue. Traffic volumes on Fairview Avenue are very low. The volumes on Eastlake are higher, but are very reasonable for the roadway character. Frequent transit service is available in the area.

Navigational Risk

The existing situation with regard to the navigational risks associated with either Lake Union site include passage through the Lake Washington Ship Canal as far as Lake Union; the risks, described briefly under the Sand Point site description, include passage through three bascule bridges. Recreational boating in the area is heavy.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

No significant geological impacts are expected at either site. More excavation and site preparation would be required for development of the private site. The minor changes to landforms that would result are shown in Figures 2-18 and 2-19.

Soils

No long-term permanent impact is expected on the soils at either site. Construction impacts, including additional filling and dredging, and temporary on-site soil and rubble storage, would be short-term and would not have significant adverse effects on soils.

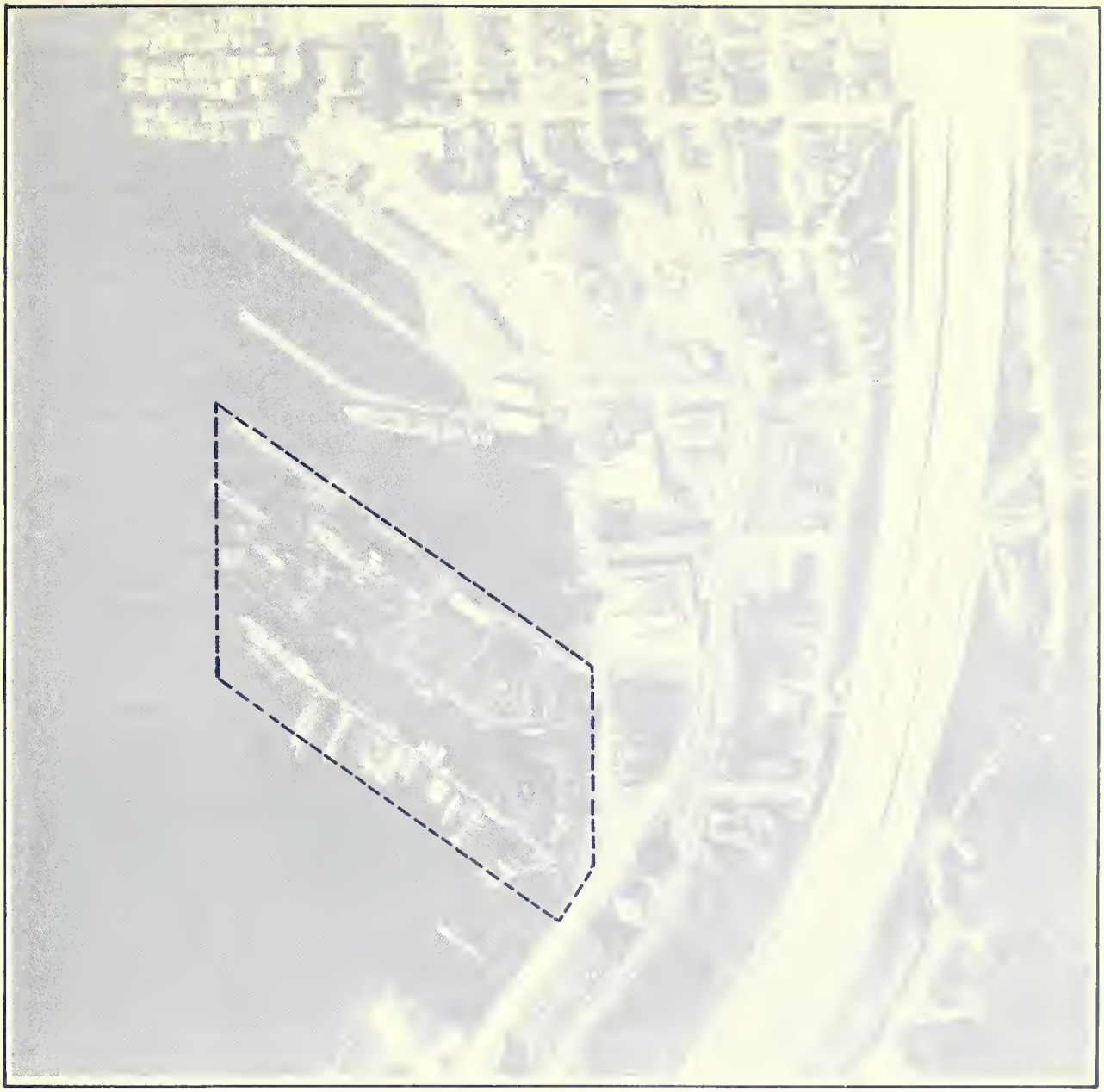
Air Quality

The local air quality impacts of the Lake Union split site alternative would be minor. Splitting the sites would distribute traffic-related emissions between the two sites according to trip ratios. The net effect would be less vehicle emissions at each site than at a consolidated site alone. Nonetheless, greater overall emissions may result due to necessary additional traffic between sites.

Operational air quality impacts would be slight. Sulfur dioxide and total suspended particulate levels would be increased by ship operations (see Appendix C); however, no standards would be exceeded when these emissions are added to estimated background concentrations. Increases in traffic volume would be small; even under worst case conditions the expected carbon monoxide concentrations would be well within levels established by applicable standards. The traffic expected at Sand Point under a split site alternative would be slightly less than if the site were consolidated. As in the consolidated case, neither the 1- nor 8-hour carbon monoxide standards are exceeded.

Water Quality and Aquatic Biology

Impacts due to development of either site would be relatively minor (See Figures 2-17 and 2-19). The waters of both the PMC and the Drydock sites are deep enough that little



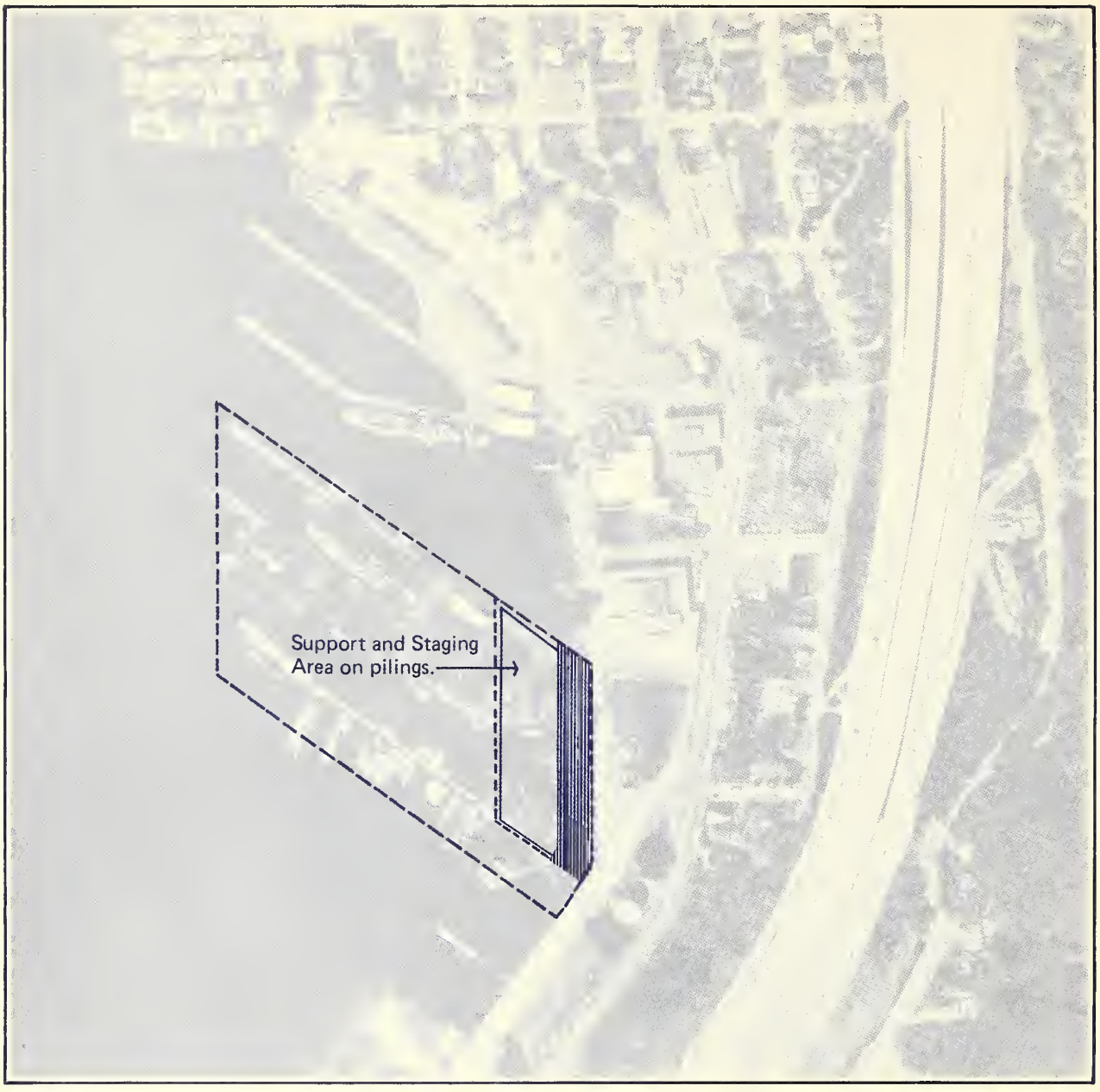
Legend

Note.
Sediment Sampling Sites
same as Figure 2-16.

500 1000
Scale in Feet

Figure 2-18

Lake Union South Site (Drydock) - Existing Conditions



Legend | Fill Area

500 1000
Scale in Feet

Figure 2-19

Lake Union South Site (Drydock) - Impacts

dredging would be needed. The Drydock site appears to need no dredging, whereas upgrading the PMC site would require dredging of less than one acre. One-half acre at either site would be filled and rip-rapped. The sediment analysis for the PMC slip showed clean bottom material with relatively high concentrations of copper. Dredge disposal could occur on-site behind berms. Although the amount of needed dredging is small, it would be desirable to conduct all dredging behind a silt curtain to avoid off-site turbidity; this measure would maintain the pleasing aesthetic quality of the lake, since it is in the center of the city and widely viewed. Given the low levels of dissolved oxygen in Lake Union during the late summer, dredging could be confined to the winter months when the lake is well mixed. Such timing would also minimize the impact upon fish migration through the area.

Construction at either site would result in the loss of one-half acre of lake surface. The rip-rap and bulkhead character of the shoreline of the PMC site would remain unchanged. The relatively natural features of the Drydock shoreline would be replaced with fill and rip-rap. No rooted aquatic plants now grow at either site; therefore, construction impacts would be minimal. The loss of a half an acre of lake bottom at either site would probably have negligible impact upon Lake Union as a whole, given the low productivity of the area.

Since the ship operations are already centered on Lake Union, continuing use of this site for these operations would not have additional impacts upon the water quality of the lake.

Terrestrial Biology

Development of either of these sites as the waterfront portion of a split-site alternative would have no significant impacts on terrestrial biota.

Natural Resources

No discernible impacts on natural resources would result from the proposed development at either Lake Union site.

Aesthetics

Development of NOAA facilities and mooring of ships at the Lake Union location would be aesthetically similar and largely in conformance with the surrounding area.

Archaeological and Historic Resources

No impacts are expected.

Noise

Construction noise at the Lake Union sites should not adversely impact local areas because the industrial and commercial land uses adjacent to these sites are not noise sensitive. Residential housing is shielded by buildings or located at sufficient distances to be protected from construction noise. Pile driving noise is expected to cause only minor impacts.

Noise impacts from vessels, normal facility operation, and vehicle traffic will be insignificant because of the existing industrial activities in these areas, the

absence of nearby noise sensitive receptors, and the low levels and frequency of operations of NOAA activities at these sites. The noise levels at these sites will be within state and federal noise criteria (see Appendix D).

Demography

Since NOAA is now operating within the Seattle region, if the NOAA facility were to locate at one of the Lake Union sites and Sand Point, population growth, housing, and unemployment levels should not be affected.

Economic Forces

Both sites are privately owned. The northern site is leased by NOAA and is the location where NOAA ships are presently berthed. If NOAA were to buy either site, real estate taxes would no longer be paid, a loss to the local jurisdiction. The trade-offs among other increased revenues and costs associated with the facility should be considered.

The southern site is industrially zoned. If NOAA were to locate there, that industrial use would no longer exist. With limited industrial zoned property available, a decision to take industrial property for this purpose should be evaluated carefully. Furthermore, the proposed site is presently being used by industry. If NOAA locates here, it will displace workers and the industry itself.

Retaining NOAA in the Seattle area will assure continued federal employment and a continued diversified employment base. Most NOAA employees and their families will continue to live in their present homes, thus avoiding relocation and its associated costs and environmental impacts.

Land Use

The NOAA facility would be compatible with the Seattle Shoreline Master Plan, zoning and other uses within the vicinity of these sites. There would be no secondary impacts associated with relocating employees and their families in the surrounding area since they are already working and living in the Seattle area.

Utilities and Energy

To provide alternate flow and increase quantities from the existing 8-inch watermain to the proposed sites, the 12-inch watermain from E. Newton Street should be extended south to a connection with the 8-inch watermain. The Water Services Director of the Seattle Water Department has determined that with this improvement the system would be adequate to handle the estimated flow demands of the NOAA center.

The Seattle Engineering Department has determined that the existing public and private sanitary facilities at the site should be adequate for handling NOAA's projected sanitary sewer flows.

Power requirements are identical to those cited for the Sand Point facility.

Public Services

Impacts on public services would not differ from those described for the Sand Point site, except for fire protection.

The Seattle Fire Department has indicated that current response in the vicinity of the site would be adequate in terms of the number of firefighters

and equipment responding, and in terms of response time. Access problems may develop in the future if traffic diversions and barriers are installed in the area as has been recently discussed.

Transportation and Circulation

Since NOAA's Pacific Marine Center is already located at this site, no additional traffic impact is anticipated if this location is chosen for the waterfront portion of NOAA operations (See Figure F-1C).

Navigational Risk

There would be no increase in navigational hazards at either site since the NOAA vessels are already based and operating in Lake Union.

SECTION 10: SALMON BAY

EXISTING ENVIRONMENT

Geology and Landforms

The Salmon Bay site is relatively flat, and reaches a maximum elevation of approximately 25 feet. The site is bounded on the south by water and on the north, east and west by land of approximately the same elevation, sloping gradually to the north (see Figure 2-20). The geology of this site has been substantially modified by human activity. Underlying geological deposits probably include glacial till, and layers of sand and clay (Liesch, et al, 1963). Seismic damage, discussed under "regional geology", is the only geologic hazard at this site. Liquefaction of the fill might be a problem; however, detailed engineering studies would be needed to evaluate the actual potential hazard.

Soils and Erosion

Most of the site is paved; soils on the site have been extensively modified by filling and excavation. Little erosion hazard is present because the terrain is level and little exposed soil is present.

Climate

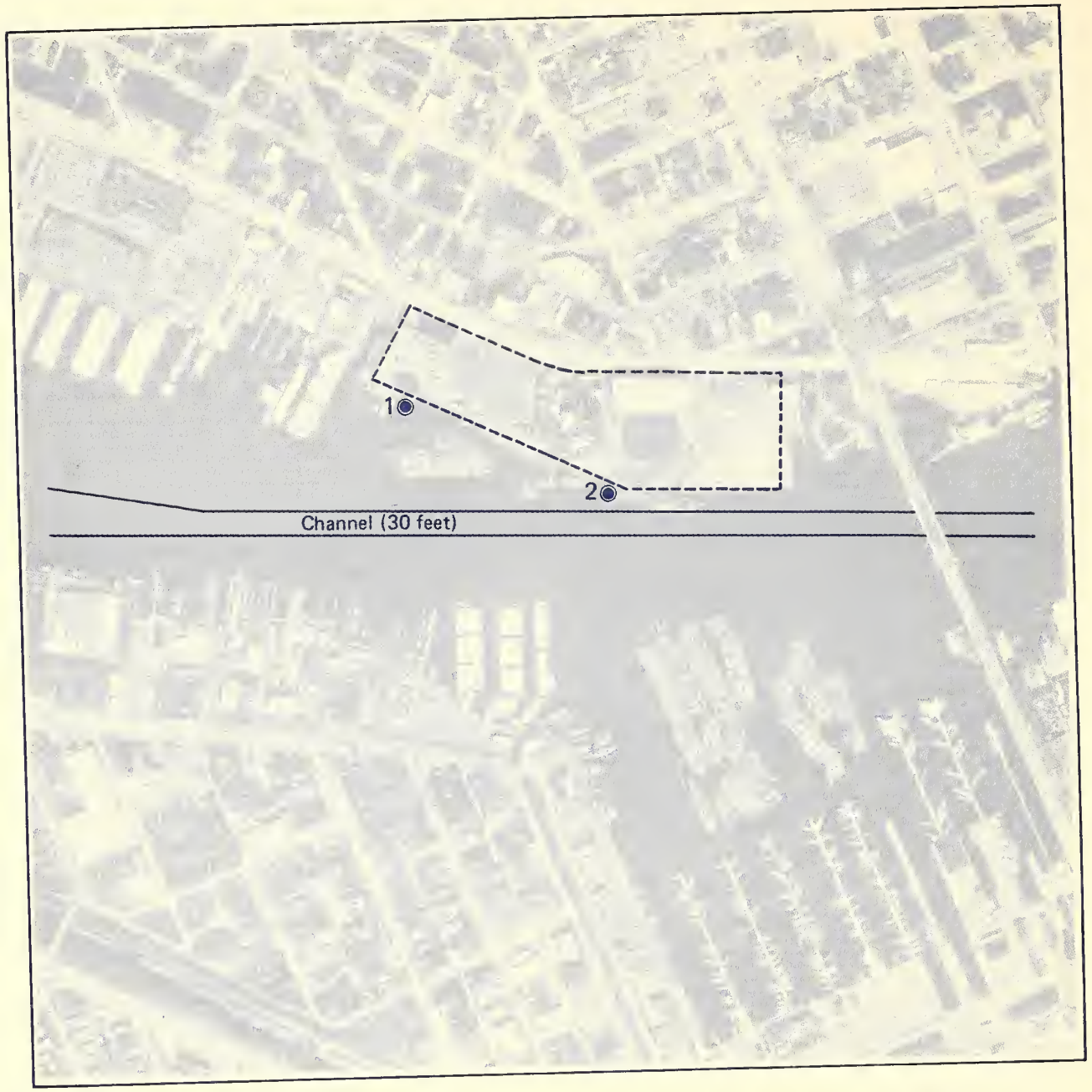
Climate at Salmon Bay does not differ significantly from that of the sites near the water and along the ship canal. Some channeling of winds through the canal may occur, giving winds at the site a more westerly component than at most locations in the Puget Sound area. Temperatures may be slightly moderated by the proximity to Puget Sound.

Air Quality

The air quality discussion for the Lake Union sites also applies to the Salmon Bay site except that total suspended particulate levels at the closest station are slightly lower.

Water Quality and Aquatic Biology

The Salmon Bay site is located in the Lake Washington Ship Canal, which has been placed in the Lake Class by the Washington State Department of Ecology. Low dissolved oxygen and high coliform levels have been observed in Salmon Bay (see Figure B-3). All anadromous fish runs in the Lake Washington drainage pass through



Legend | ● Sediment Sample Site

500 1000 1500

Scale in Feet

Figure 2-20

Salmon Bay Site
Existing Conditions

Salmon Bay. Sediments in the area are heavily contaminated. Monitoring data collected by METRO show a reduction in the dissolved oxygen of the bottom waters during the late summer. During the period of summer lowflow some brackish water flows through Salmon Bay toward Lake Union. As a result of urban runoff and combined sewer overflows coliform levels tend to increase along the Ship Canal between Lake Washington and the Locks. The highest median counts are found in Salmon Bay. (See Table B-12.)

The aquatic life of concern at this site includes only anadromous fish passing the site. The shoreline around Salmon Bay is heavily industrialized and very little shallow area is present. It is unlikely that the Bay is a desirable habitat for resident fish or aquatic plant life. All anadromous fish entering or leaving the Lake Washington drainage pass through Salmon Bay. Figure B-2 shows the periods of the year when migrating fish are passing through the area.

Analysis of samples sediment taken just offshore from the docks at the site (Table B-12) showed high levels of organic material, oils and grease, and copper. The poor chemical quality of the sediments is a result of the industrial activity at the site.

Terrestrial Biology

The Salmon Bay site is a heavily industrialized site in an area characterized by similar uses. The site has little vegetation and has negligible significance as wildlife habitat. See Appendix E for species lists.

Natural Resources

No mineral or other natural resources are present on this site.

Aesthetics

This site, used by heavy industry and located in an area dedicated to comparable industrial and commercial uses, is viewed only by distant residential areas across the Lake Washington Ship Canal. Extensive ship traffic on the canal can be viewed from the site.

Archaeological and Historic Resources

Although shoreline locales were favored by Indians in this area, and archaeological materials may have been present on the site, it has been so extensively disturbed by excavation and filling that no intact resources are likely to be present. No such resources are known to exist on the site.

Noise

Noise levels near Salmon Bay (See Appendix D) are dominated by road and industrial noise. Daytime noise levels are typical of those found along commercial street arteries and in industrial areas. The daytime noise levels are suitable for industrial use but marginally or unacceptable for most residential areas.

The Salmon Bay site is located on the Lake Washington Ship Canal; the regional noise environment is the same as described for the Lake Union sites.

Demography

The demographic discussion under "Sand Point" also applies to the Salmon Bay site, since it is also in Seattle.

Economic Forces

The economic forces affecting the Seattle-King County area are discussed under the "Sand Point" site description.

Land Use

The Salmon Bay site, a privately owned site, is now used for industrial purposes (sand/gravel/lumber operations). The surrounding area is also extensively used for industrial purposes. There are no residential areas near the site.

The City of Seattle has zoning jurisdiction of the site and the shoreline. The site is zoned "I-G" and "I-H", which represents general and heavy industry. Seattle has designated the shoreline as "UD", Urban Development, a designation that allows all shipping and water-dependent industrial facilities, pilings, bulkheads, dredging, filling and breakwaters.

Utilities and Energy

Water service is provided by the Seattle Water Department. The existing watermain in Shilshole Avenue N.W. is 16 inches in diameter. Water pressure is about 128 psi static.

Sewer service is provided by the City of Seattle, and METRO. There are three existing side sewer connections to a 66-inch METRO sanitary on Shilshole Avenue N.W. Storm runoff could be discharged directly into Salmon Bay or connections could be made to the existing 21-inch City storm drain on Shilshole Avenue N.W.

Power is provided by Seattle City Light.

Public Services

The availability of public services is the same as described for the Sand Point site.

Transportation and Circulation

Direct site access is provided by Shilshole Avenue. The site is separated from Shilshoe by railroad tracks. The predominant route to disperse traffic from the Shilshole area appears to be NW Market Street. Major intersections in the area are signalized, and existing street geometry is adequate for existing traffic. Traffic volume on Shilshole is moderate for the roadway character. NW Market Street is carrying low to moderate volumes for a four-lane roadway. Transit service is available in the area.

Navigational Risks

The conditions affecting navigational risk at the Salmon Bay site differ little from those affecting the Lake Union sites, except that transit through only one bridge would be required.

IMPACTS AND MITIGATIVE MEASURES

Geology and Landforms

Development at this site would not significantly affect the geology or landforms of the site or region.

Soils

No long-term permanent impact is expected on the soils at this site. Construction impacts, including additional filling and dredging, and temporary on-site soil and rubble storage, would be short-term and would not have significant adverse effects on the soils.

Air Quality

Air quality impacts at the Salmon Bay site differ little from those discussed for the Lake Union sites, except with respect to carbon monoxide levels.

Traffic volume would increase, raising carbon monoxide levels near roads (see Appendix C). Carbon monoxide (CO) analyses (assuming worst case conditions) indicate that both the 1- and 8-hour CO standards would be exceeded immediately above 15th Avenue NW. (Both standards are met at 10 meters from the road.) The proposed project's contribution to this standard exceedance is essentially zero, however, since only 78 cars per day are expected to use this route. The other two routes show CO concentrations within the standards. The CO concentrations expected at Sand Point under a split site alternative are discussed under the Lake Union split site alternative. All of the traffic analyses used the previously described methodology.

Mitigative measures to alleviate the CO standard violations are related to traffic controls and alternative transportation methods. Operation of the proposed project would not significantly affect air quality along 15th Avenue NW because of the small amount of traffic volume expected to use this route.

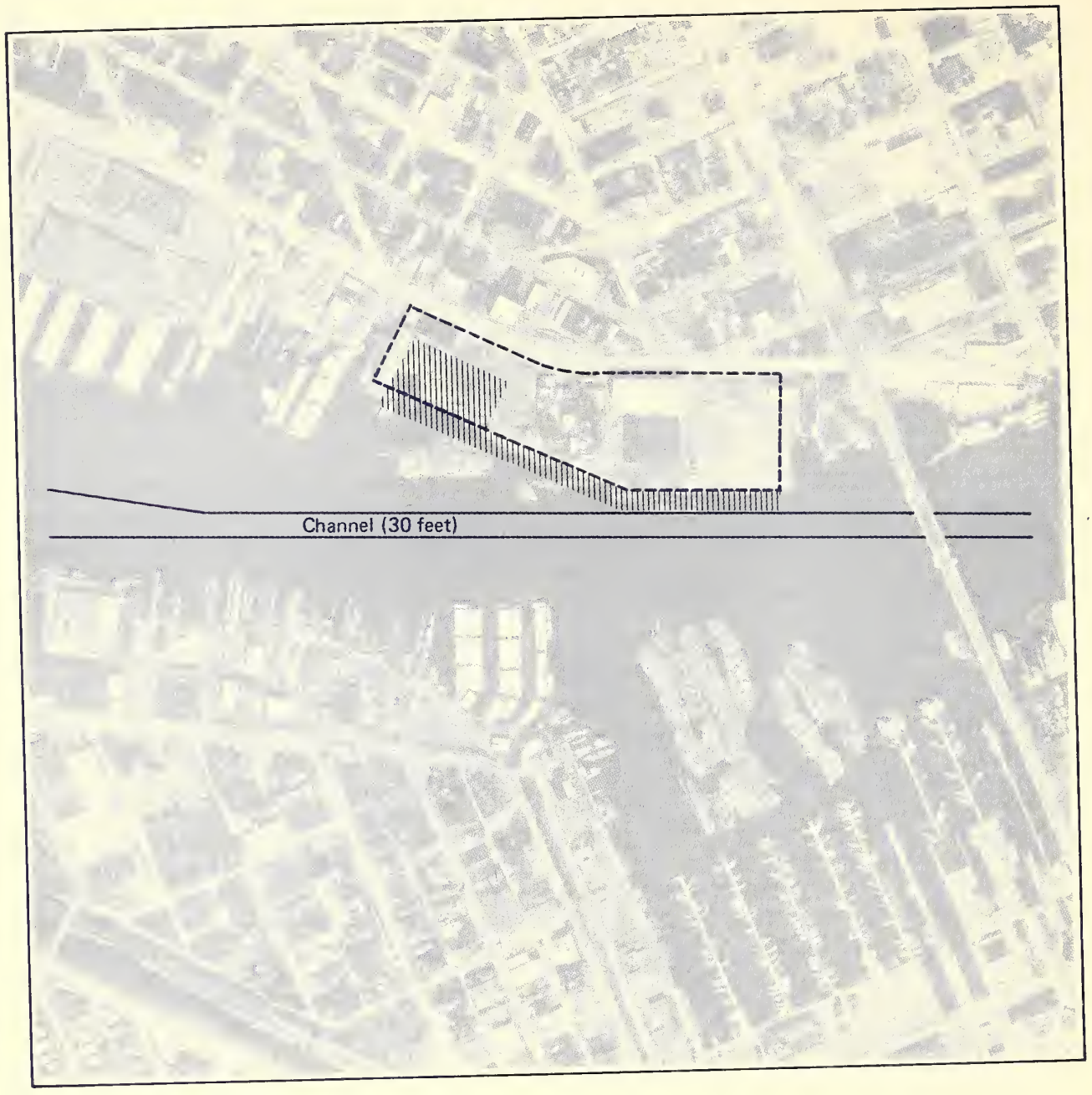
Water Quality and Aquatic Biology

Development of the Salmon Bay site would require a small amount of dredging adjacent to the shore (see Figure 2-21). In addition, approximately three acres of dredging and excavation would be required at the western end of the site to attain the necessary berthing space. Because the sediment at the site is highly organic in composition and somewhat contaminated with lead and copper, upland disposal would probably be necessary.

The site lies adjacent to the path of the salmon migration route through the Ship Canal to the entire Lake Washington drainage. It is important that the dredging be timed so as to cause minimum interference with this migration.

The biological impacts of dredging and construction would be minimal as the site has been industrialized for many years. No rooted aquatic plants appear to grow at the site. Due to the limited extent of dredging, water quality impacts would be small. Considerable local turbidity would occur. The chemically reduced nature of the sediments would result in a locally depressed level of dissolved oxygen during the dredging, but these would both be short term effects.

Operation of the ship facility is unlikely to cause significantly different water quality impacts than those caused by the present use of the site. The dominant use of Salmon Bay is for ship berthing, loading, and servicing. The proposed NOAA facility would follow this usage. Oil containment berms would surround the facility to prevent off-site spreading should a dockside fuel spill occur.



Legend Dredge Area

500 1000 1500

Scale in Feet

Figure 2-21

Salmon Bay Site - Impacts

Terrestrial Biology

No negative impacts on the terrestrial biology of the Salmon Bay site would be caused by development of the proposed waterfront facilities. Any landscaping included in the plans would constitute a slight beneficial impact on terrestrial biology.

Natural Resources

Development of the proposed waterfront facility at this site would have no discernible impacts on natural resources.

Aesthetics

If built here, the NOAA facility would replace industrial buildings on the site. The NOAA ship activity would be similar and largely in conformance with the surrounding area.

Archaeological and Historic Resources

No impacts are expected.

Noise

Noise impacts for the Salmon Bay site do not differ from those for the Lake Union sites.

Demography

If the NOAA waterfront facility were to locate at Salmon Bay, population growth, housing, and unemployment levels should not be affected since NOAA is now operating within the Seattle region.

Economic Forces

The economic impacts of locating the waterfront facility at Salmon Bay are essentially the same as those of locating it at the Lake Union drydock site, except that a different industrial site would be affected.

Land Use

No adverse impacts would result from development of the NOAA facility on this site. The proposed development would comply with the Seattle Shoreline Master Plan Program and Seattle zoning regulations.

Utilities and Energy

The Water Services Director of the Seattle Water Department has determined that the existing system is adequate to provide NOAA's estimated domestic water and fire flow demands.

The existing METRO trunk is more than adequate to handle projected NOAA flows. Additional 8-inch side sewers could be connected to the trunk if necessary. The distance from the property line to the trunk is approximately 85 feet. The Seattle Engineering Department has determined that the existing sanitary facilities are adequate for conveying sanitary sewage from the site.

Seattle City Light representatives indicate that NOAA's estimated demand could be met with presently available resources.

Public Services

Impacts on all public services except fire protection would be identical to those described for the Sand Point site. The Seattle Fire Department has indicated that the current response in terms of firefighters and equipment responding, and in terms of response time, would

be adequate to provide service to the proposed facility.

Transportation and Circulation

Development of the waterfront facility at Salmon Bay would not create traffic problems in the area. The trip generation for the NOAA site will probably be less than the manufacturing operation it replaces. Some minor congestion can be expected along Shilshole Avenue when the industries along the street change shifts. When traffic departs the immediate site area it will generally be traveling in the direction opposite to the existing peak hour flow. No bridge openings would be required. No additional adverse impact is expected on traffic operations. Expected traffic volume is shown in Figure F-1C.

Navigational Risk

The navigational risks would actually decrease if the Salmon Bay site were selected for development of the waterfront portion of the facility. Since NOAA vessels would no longer have to pass under the Ballard Bridge, the risk of ramming would drop.

3 Comparison of Alternative Sites

The purpose of this chapter is to bring together information that will allow the reader to understand environmental trade-offs or differences between the alternative sites. First, impacts on each element of the environment are compared. Then, a summary table is presented, and those sites that would be associated with the most and least severe environmental impacts are identified.

SECTION 1: ENVIRONMENTAL ELEMENTS

GEOLOGY AND LANDFORMS

Excavation and filling during construction of the facilities would modify geology and landforms slightly on all sites. Many of the consolidated sites are presently fill; impacts to these sites are considered minor. The South Mukilteo site, characterized by steep slopes and poor stability, would probably require the greatest change to an upland site. The North Hylebos and Everett sites would require extensive filling; excavation would be required at the Kenmore and South Hylebos sites. Relatively little change would result from development of the remaining sites, including the split site alternative waterfront sites.

SOILS AND EROSION

Impacts on soils would be relatively minor regardless of which site is chosen for a consolidated facility. The greatest potential for

on-site erosion is present at the South Mukilteo site because of its steep slopes; however, appropriate methods of handling storm runoff, especially during construction, would avoid substantial erosion. Large amounts of soil would have to be added to the North Hylebos and Everett sites. Natural soils would be disrupted at Manchester, but the slope is so low that erosion hazards would be minimal. Impacts on soils would be minor for any of the waterfront sites; the impact would be least for the Pacific Marine Center (PMC) site at Lake Union where NOAA ships are presently moored.

CLIMATE

Climate would not be affected by development of any of the sites, consolidated or split.

AIR QUALITY

A major concern in the evaluation of air quality impacts is whether standards would be violated. Construction impacts would be similar for all sites; there would be increased levels of gaseous pollutants and dust, but these emissions would not cause any standards to be exceeded. Ship operations result in the emission of gaseous pollutants and particulates both along the travel route, and in port when the vessels are preparing to depart. The emissions generated in-port are more likely to adversely affect air quality. Maximum sulfur dioxide and total suspended particulate concentrations attributable to the ships' operations would be somewhat greater at the South Mukilteo site than at the other sites because of the high bluff located there. Sulfur dioxide emissions would aggravate existing problems in both Tacoma and Everett; however, the relative orientations of the monitoring stations, other sources, and the sites are such that more frequent exceedance of standards is likely only for the two Tacoma sites. Sulfur dioxide problems could be mitigated by use of low sulfur fuel, the requirement that the SURVEYOR leave port only during periods of off-shore winds, or making engine modifications to reduce emissions.

It is possible that total suspended particulate standards would be exceeded near the Kenmore site if the ships' plumes were to interact with air currents carrying high levels of particulates from the cement plant. Carbon monoxide (CO) levels would increase as traffic volumes increase; the only consolidated site near which exceedance of CO standards is likely is the Kenmore site. Carbon monoxide levels would be decreased by reducing traffic volume, by means such as encouraging the use of transit or carpools.

Emission of air pollutants would be particularly noticeable in locations where standards are least likely to be exceeded. At the Manchester site degradation of air quality would be particularly noticeable because existing sources of pollutants other than hydrocarbons are so sparse. The South Mukilteo site is also located in residential areas with few major pollutant sources.

The overall quantity of pollutants emitted would be slightly higher if a split site alternative were implemented than if a consolidated site was chosen, since additional travel between the two locations would be required; however, the concentrations at each portion of the site would be lower. The greater the distance that ships have to travel to reach port,

the larger the quantity of pollutants that they will emit. In order of increasing distance, the sites are as follows: Everett, South Mukilteo, Port of Tacoma, Hylebos, Manchester, Sand Point, and Kenmore.

Air quality impacts from operation would be similar at any of the split site locations. Although NOAA operations would contribute little to traffic increases, these traffic increases would be greater for the Salmon Bay site, and violations of carbon monoxide standards in the area are likely. Ship travel distance would be somewhat greater for either of the Lake Union sites than for Salmon Bay.

WATER QUALITY AND AQUATIC BIOLOGY

The sites vary considerably with respect to the amount of dredging, fill or other alteration to the shoreline and offshore area, impacts on the benthic community, impacts on fish populations, ease of containment of oil spills in port, and other water quality impacts.

Substantial amounts of dredging or other modifications would be required to develop berthing facilities at several of the consolidated sites. Twenty-eight acres of shallow lake bottom would have to be dredged at Kenmore, generating a million cubic yards of spoils for which upland disposal sites would probably be required. Maintenance dredging would also be necessary and slips would have to be excavated into the existing shoreline. At Manchester, up to 25 acres of dredging would be required; development of the South Mukilteo site would require up to 20 acres (600,000 cubic yards) of dredging. Open water disposal would probably be possible for spoils from either site. In addition, a 0.6 mile rock breakwater and filling of two acres of intertidal area would be needed at the South Mukilteo site. At the Sand Point site about 13 acres of dredging (an estimated 360,000 cubic yards) would be needed. Development of the North Hylebos site would require filling 69 acres of tidelands, dredging of up to 10 acres of highly organic sediments, and replacing 6,000 feet of shallow shoreline with 4,000 feet of rock rip-rap shoreline that drops off steeply. Ten acres of fill would have to be excavated to construct slips at the South Hylebos site. Changes at other consolidated sites would be minimal.

Changes at the split sites would be comparatively minor. Development of either of the Lake Union split sites would require filling a half-acre of the lake; less than an acre of dredging would be needed to upgrade the PMC site. Three acres of dredging and some excavation would be required at Salmon Bay.

Impacts on benthic communities parallel the extent of dredging or filling. Dredging not only destroys organisms, but by increasing the depth, decreases the productivity of the habitat. Hence, development of the Manchester, North Hylebos or South Mukilteo sites would eliminate 25 to 60 acres of productive marine shallows, decrease the size and diversity of the benthic population, and, at Manchester and South Mukilteo, eliminate some productive eelgrass beds. The impact due to development of the North Hylebos site would be particularly severe since the 60 acres of intertidal area to be eliminated is one of few remaining areas of this type of habitat in Commencement Bay. In contrast, the loss of 80 acres in Everett would be much less significant since the area involved is not high quality habitat.

Impacts on fish and shellfish would also vary from one site to another. Impacts could be quite severe for the Manchester site: hardshell clams would be destroyed by dredging, crab habitat would be lost, and construction or NOAA vessel operations might interfere with the aquaculture operation. The North Hylebos site is thought to be an important shelter and feeding area for juvenile salmon in Commencement Bay. Development at Sand Point or Kenmore would eliminate shallows used for spawning and rearing by resident fish and by salmonids near Kenmore. Sockeye salmon are believed to spawn in a beach area that would be altered by development at Sand Point. Impacts upon the aquatic communities resulting from the development of the waterfront facilities at any of the split site alternatives are the same.

Containment of small oil spills in the mooring area would be more difficult at some consolidated sites. Although a system similar to that employed at the Pacific Marine Center on Lake Union would be adequate for most sites, stronger currents at the South Mukilteo and Manchester sites would require a larger securely anchored barrier. At all split sites, an oil boom similar to that used at the PMC would be adequate.

Other water quality impacts would also vary from one consolidated site to another. Circulation would be reduced in the vicinity of the Everett site, resulting in lower dissolved oxygen levels and higher levels of industrially discharged pollutants such as color, turbidity, and toxicants. Narrow slips at the Kenmore site could create similar circulation problems. At South Mukilteo, the high erosion potential could result in increased turbidity from storm runoff. At the Manchester site, the low levels of toxicants emitted by the sites could interfere with ongoing research thus requiring relocation of the laboratory's salt water intake, or the nearby aquaculture operation. Elevated levels of coliforms and other pollutants are likely to result from storm water runoff near the Manchester site. All split sites are similar in that no significant impacts would be expected.

TERRESTRIAL BIOLOGY

Impacts on terrestrial biology vary with the type of habitat presently available at each consolidated site. Impacts would be negligible at Everett. Impacts would be slightly greater for the South Hylebos site, which is somewhat less disturbed. Sand Point provides a habitat apparently used by a wide variety of birds, hence impacts would be slightly greater than for the previous sites. Impacts would be more noticeable from development of the South Mukilteo or North Hylebos sites. The South Mukilteo and North Hylebos sites are relatively large natural areas. The latter, used by waterfowl, is one of few remaining intertidal areas in Commencement Bay. Shallow areas adjacent to the Kenmore and Manchester sites are important waterfowl areas. Impacts on the split sites would differ little, for all split sites the impacts would be negligible.

NATURAL RESOURCES

Impacts on natural resources differ little for the consolidated sites. Sand Point and South Mukilteo sites can be considered somewhat more valuable because of their

importance to terrestrial wildlife; the North Hylebos and Manchester sites have value as fishery resources. For the split-sites no discernible impacts would occur.

AESTHETICS

Aesthetic impacts have been evaluated from the perspective of what impact the NOAA facility would have on the surrounding region. The consolidated facility would enhance the appearance of all regions except for those near Sand Point, Manchester, Kenmore, and South Mukilteo where the docking facilities might be considered unattractive by some people.

The only aspect of the facility that might be thought to adversely affect aesthetics near the South Mukilteo, Kenmore, and Sand Point sites are the moorage structures and the ships. Although many persons would consider the view of a passing NOAA ship attractive and interesting, the dock structures associated with their home base might be considered unappealing, especially by those who reside on hillsides above the dock structures or those whose view is affected by the structures. This impact would affect more homes near Sand Point than any other site. Nonetheless, many, particularly those viewing the site from the east side of the lake and from the water, would find the NOAA facility aesthetically preferable to the naval air station facilities presently on the site. Fewer homes would view the facility at Kenmore. In addition, the Kenmore area is already a predominantly commercial and industrial area; hence the NOAA ship facility would not significantly change the aesthetics of this region. Dock structures at South Mukilteo would be visible only from homes across Puget Sound on Whidbey Island. The dock structures would be visible by passing boaters regardless of the site selected. The aesthetic impact from the water would be greatest at Manchester where the facility would contrast sharply with the undeveloped character of the shoreline and adjoining land areas.

Any of the split-site alternatives using Sand Point as the location of the laboratory/office complex with ships located elsewhere would avoid potentially adverse aesthetic impacts to Sand Point. Quality design and extensive landscaping would increase the aesthetic appeal of the facility at Sand Point, South Mukilteo, Lake Union, or Manchester. Standard design with minimal landscaping would suffice to maintain the aesthetics of the other sites.

The aesthetic impacts would vary little among the split sites. The facility would have a positive impact on either the Lake Union drydock or the Salmon Bay site. Little change would result from selection of the PMC site at Lake Union.

ARCHAEOLOGICAL AND HISTORIC RESOURCES

The Manchester and South Mukilteo sites are the only sites where any significant impact on archaeological or historic resources is likely. Development of the Manchester site would affect a Historic Preservation District, and might affect archaeological resources. Although no archaeological resources are known to be present on the South Mukilteo site, much of the site is relatively undisturbed.

NOISE

Increased noise levels should be considered an adverse impact when a noise sensitive receptor (such as a

residential area) is affected. A few residential areas would experience noticeable increases in noise levels if the facility were located at South Mukilteo or Kenmore. Smaller increases in noise levels in residential areas would result from the development of Sand Point or Manchester. No impacts would occur if any of the other consolidated sites were selected. Similarly, no impacts would result at the waterfront portion of any split site.

DEMOGRAPHY

Population growth and the need to develop additional housing are considered adverse only when the growth is greater than that anticipated or when plans to accommodate the additional population are inadequate. Thus, although population growth would occur for any of the sites outside the Seattle area, such demographic change would be a serious problem only for the Manchester site.

ECONOMIC FORCES

For many consolidated sites, economic factors would be positive rather than negative. Four factors were considered in evaluation of the economic impact:

- Would the NOAA facility make the use of an industrially zoned site unavailable to industry?
- Would the NOAA facility displace an existing industrial use and its corresponding industrial employment presently on the site?
- Is the site privately owned, such that real estate revenues would be lost if the land were purchased by NOAA?
- Would the NOAA facility help maintain or would it diversify the region's economy?

All consolidated sites other than Sand Point and Manchester are zoned industrial; however, only the Kenmore site is currently used by industry. This site is privately owned, as are the South Mukilteo and South Hylebos sites. Economic diversity of the surrounding region would be furthered by the development of any site except Manchester. Thus, by these criteria, development would be most favorable at the Sand Point, Everett or North Hylebos sites, since each is publicly owned, presently unused by industry, and would contribute to economic diversity if used by NOAA.

The split-sites differ little from each other. All are publicly owned, industrially zoned and, except the PMC site, are currently used for industrial purposes. All are in Seattle; therefore, economic diversity considerations and local costs and revenues are the same for all sites.

LAND USE

Comparison of land use impacts is based on compatibility with shoreline designation, zoning and land use plans, and existing use of surrounding land. With conditional or special uses identified for some of the alternate sites, at all sites the NOAA facility is compatible with the approved master programs of each jurisdiction. With minor complications for some sites, the NOAA facility would be compatible with all local zoning ordinances. Generally, the only consolidated sites where development of the proposed facility would be in conflict with existing land use are

Manchester, Sand Point, and Kenmore. Both the Kenmore and Sand Point sites are appropriate for land operations of laboratories and office space, but the shoreline use for docks and ship moorage may be considered incompatible with the recreational use of the lake and with the residential areas surrounding the sites. In addition, at Kenmore the operation of seaplanes and NOAA ships in the same vicinity is a potential conflict. Manchester is the least desirable site with respect to land use because of its undeveloped shoreline designation and the surrounding rural land use that would be affected by locating the facility there. Currently planned rezoning of the South Mukilteo site would make the facility compatible with the shoreline and land use designations. Opening part of the shoreline for public use at the South Mukilteo, Manchester, Sand Point and Kenmore sites would minimize some of the incompatibilities of locating at any of these sites. The split sites are the same with respect to land use compatibility; no incompatibility exists for any of the sites.

UTILITIES AND ENERGY

Public utilities would constitute a major problem only for the Manchester site. At that site, provision of domestic water supply would require drilling additional wells, and fire flows could not be provided by the water district. Sewer service would require a 7000 foot force main and a pump station; capacity of the sewage treatment plant may also be inadequate. Water supply for the Everett site would require a larger main; sewer service for that site would require a private force main and larger pumps in two pump stations. A private pump station and force main would be required to serve the Kenmore site. No significant changes to public utilities would be required to serve the remaining sites.

PUBLIC SERVICES

Only for the less developed sites would public services be adversely affected. The most severely affected area would be Manchester, where schools are seriously over capacity and being filled faster than new ones can be built, where the Sheriff's Department is so overloaded that it cannot provide adequate service, and where adequate fire flows could not be provided by the water district. In Kenmore, the existing problems with rising school enrollments would be aggravated. Near the South Mukilteo site, NOAA related growth would ensure that planned increases in facilities and manpower are needed. The Seattle Fire Department might need to increase equipment and manpower near Sand Point if that site were selected. The Tacoma schools would be benefited by increased enrollments if either of the Tacoma sites were selected. No significant impacts on services would result from development of the waterfront split-site facilities.

TRANSPORTATION AND CIRCULATION

Impacts on traffic and circulation would be minor for all consolidated sites except Manchester. Impacts would be negligible for the Everett site. The only noticeable impact due to selection of the Kenmore or Sand Point sites would be a slight increase in the number of bridge openings of the Montlake and University Bridges (up to 120 per year);

however, few of these openings would occur during peak traffic hours. Up to 120 additional openings per year of the 11th Avenue Bridge in Tacoma would be necessary if the South Hylebos site were selected, whereas, if the North Hylebos site were selected traffic volumes crossing that bridge would increase, resulting in greater disruption of traffic when that bridge is not operational. Selection of any other consolidated site would avoid bridge-related impacts; traffic disruption in Seattle would decrease. The freeway interchange that would be used for either of the Tacoma sites now has operational problems, but any effects of the NOAA traffic would be insignificant. Development of the South Mukilteo site could cause congestion and traffic levels inappropriate to the roads in residential areas near the site unless an access were developed from Chenault Beach Drive prior to the point where it enters residential developments. Development at Manchester would seriously overburden the capacity of the Washington State Ferry System. This impact is unavoidable even with the implementation of vanpooling and early relocation of NOAA employees.

Transit service and availability also varies for the consolidated sites. Transit service to Sand Point is excellent; service to Kenmore and Everett is also reasonably frequent in peak hours. The North and South Hylebos sites can be reached by bus only between 7 A.M. and 5 P.M. No transit service is available to the South Mukilteo and Manchester sites.

NAVIGATIONAL RISK

Navigational risks vary with the potential hazards and existing traffic levels at each site. The only common base by which the sites can be compared is provided by the accident rate data discussed in Appendix A. The consolidated site with the lowest predicted accident rate was South Mukilteo, followed by Manchester and Everett. The rate at the North Hylebos site, which has a much greater traffic volume, was substantially greater than that of Everett. The rate for South Hylebos was slightly higher than that for the other Tacoma site, principally because of the additional bridge ramming hazard. The predicted rate for both Lake Washington sites (Kenmore and Sand Point), although lower than that for the Tacoma sites, was unusually high for a small port. Risks for these sites are greater because of the required passage through the entire ship canal, which includes five bridges, and the potential risk associated with entering the locks.

Among the split-site alternatives, the Salmon Bay site would have slightly lower navigational risks than the Lake Union sites. The difference is a result of avoiding the risk of ramming the Ballard Bridge.

SECTION 2: ANALYSIS OF TRADE OFFS

To facilitate analysis of the trade-offs, four summary tables are presented. These tables are intended only to aid comparison of the sites. They are not intended to summarize the text in Section 1 of this

chapter, to which the reader is referred for a more detailed discussion. In these tables, each environmental element evaluated in Chapter 2 is evaluated. In Table 3-1 and 3-2 adverse impacts associated with development at each of the alternative sites are rated high, moderate, low or zero. These ratings took into account the factors discussed in Chapter 2 and in Section 1 of this chapter. The ratings are based on the professional opinion of specialists in the appropriate environmental fields; therefore, comparisons should be made only within a given element. These ratings are influenced by existing conditions at the various sites. A numerical rank was also assigned to each of the consolidated sites for each environmental element; these ranks, listed in Table 3-3, are based on the relative adverse impact on each element. Thus, if a given site is associated with a slightly greater adverse impact on a given element than any other site, it could receive a least favorable ranking even though impacts for development of any of the sites would be relatively minor. Table 3-4 provides a comparable ranking of the three split sites. For many environmental elements, the difference between sites was so small that two or more sites are given the same rank. Thus, for many categories, the rank of the least favorable site is less than seven.

The ratings and rankings for each environmental element represent the professional judgment of the person who evaluated each element. Therefore, a mathematical approach to site comparison based on these tables would be of questionable validity. Furthermore, the significance of impacts varies among the elements; for example a moderate impact on water quality might be more important than a moderate impact on geology. These tables are, of course, relevant only to this project and these sites.

A comparison of the consolidated sites can be made by reviewing Tables 3-1 and 3-3. Comparitive ranking of the consolidated sites as to which would be most suitable based on environmental considerations would depend heavily on the weight placed on each of the environmental elements. In contrast, the split-site alternatives are quite similar; none has many adverse impacts. Thus, location of ship-related facilities at any of the split-site alternatives would avoid the impacts of development of the proposed center at Sand Point on navigational risk, water quality, aquatic biology and aesthetics.

SECTION 3: NO-ACTION ALTERNATIVE

If the facility consolidation project were abandoned, NOAA would continue on a leased facility basis This alternative would restrict NOAA activities to the limited additional leased space available at their present locations for accommodating projected growth. Additional new space in new locations would increase the present problems of dispersed facilities. The potential benefits of consolidation would be foregone.

Adverse impacts that might result from development of the proposed facility at any of the alternative sites would be avoided;

however, environmental impacts due to NOAA operations at their present locations would continue. Expansion of current operations in additional leased space would also be associated with some environmental impacts. The extent and nature of such impacts cannot be evaluated without specific information regarding which activities would expand and the type of facilities that would be required.

Property at all of the alternative sites would continue in its present use or be available for development of other uses. The sites that are now industrial would continue to be available for water-related industry. The options for Sand Point are perhaps of particular concern since that site is the proposed action; as discussed in the FEIS (NOAA, 1976) the possibilities include no change, a natural area and wildlife preserve, a park, a general aviation facility, residential use and commercial and special purpose educational/ recreational use.

TABLE 3-1

Adverse Environmental Impact Ratings[1] - Consolidated Sites

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester
Geology	L	M	0	0	M	0	L
Soils	0	M	0	L	M	0	L
Climate	0	0	0	0	0	0	0
Air Quality	M	M	M	L	M	M	M
Water Quality/ Aquatic Biology	M	H	M	M	M	L	H
Terrestrial Biology	0	M	M	M	M	L	M
Natural Resources	0	L	0	L	M	0	M
Aesthetics	0	L	L	M	0	0	M
Archaeology/ Historic Res.	0	L	0	0	0	0	M
Noise	0	M	M	L	0	0	L
Demography	M	L	L	0	L	L	H
Economic Forces	0	L	0	0	0	0	0
Land Use	0	L	L	L	0	0	M
Public Utilities	M	L	M	L	L	L	H
Public Services	M	H	H	M	L	L	H
Transportation & Circulation	M	H	M	L	M	M	H
Navigational Risk[2]	L	L	L	L	L	L	L

H = High M = Moderate L = Low 0 = Zero

[1]These ratings are based on professional opinion, not an absolute scale. This table should be used with the text in Chapters 2 and 3; in isolation it may be misleading.

[2]These ratings refer only to the increase due to the NOAA project.

TABLE 3-2

Adverse Environmental Impact Ratings[1] - Split Sites

	Lake Union PMC	Lake Union Drydock	Salmon Bay
Geology	0	0	0
Soils	0	0	0
Climate	0	0	0
Air Quality	L	L	M
Water Quality/ Aquatic Biology	L	L	L
Terrestrial Biology	0	0	0
Natural Resources	0	0	0
Aesthetics	0	0	0
Archaeology/ Historic Res.	L	L	L
Noise	0	0	0
Demography	0	0	0
Economic Forces	0	L	L
Land Use	0	0	0
Public Utilities	L	L	L
Public Services	L	L	L
Transportation & Circulation	L	L	M
Navigational Risk[2]	L	L	L

H = High M = Moderate L = Low 0 = Zero

[1]These ratings are based on professional opinion, not an absolute scale. This table should be used with the text in Chapters 2 and 3; in isolation it may be misleading.

[2]These ratings refer only to the increase due to the NOAA project.

TABLE 3-3

Comparison of Consolidated Sites[1]

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester
Geology	3	4	1	1	4	1	2
Soils	1	3	1	2	3	1	2
Climate	1	1	1	1	1	1	1
Air Quality	2	3	7	1	4	5	6
Water Quality/ Aquatic Biology	3	5	4	3	2	1	6
Terrestrial Biology	1	4	4	3	4	2	4
Natural Resources	1	2	1	2	3	1	3
Aesthetics	1	2	2	3	1	1	3
Archaeology/ Historic Res.	1	2	1	1	1	1	3
Noise	3	7	6	4	1	2	5
Demography	4	3	2	1	4	4	5
Economic Forces	2	4	5	1	2	4	4
Land Use	1	2	3	4	1	1	5
Public Utilities	2	3	2	1	1	1	4
Public Services	2	3	4	2	1	1	5
Transportation & Circulation	2	4	6	1	5	3	7
Navigational Risk[2]	1	1	1	1	1	1	1

[1]Within each environmental element (rows), sites have been ranked according to severity of expected adverse impacts on that element. The lower the rank, the less impact expected. In cases of ties, several sites may have the same rank. Where all seven sites differ 1 = lowest impact, 7 = highest impact. This table should be used only in context; without consideration of the material presented in the text of Chapters 2 and 3 it may be misleading.

[2]These ratings refer only to the increase due to the NOAA project.

TABLE 3-4

Comparison of Split Sites[1]

	Lake Union PMC	Lake Union Drydock	Salmon Bay
Geology	1	1	1
Soils	1	1	1
Climate	1	1	1
Air Quality	1	1	2
Water Quality/ Aquatic Biology	1	1	1
Terrestrial Biology	1	1	1
Natural Resources	1	1	1
Aesthetics	1	1	1
Archaeology/ Historic Res.	1	1	1
Noise	1	1	1
Demography	1	1	1
Economic Forces	1	2	2
Land Use	1	2	2
Public Utilities	1	1	1
Public Services	1	1	1
Transportation & Circulation	1	1	2
Navigational Risk[2]	1	1	1

[1]Within each environmental element (rows), sites have been ranked according to severity of expected adverse impacts on that element. The lower the rank, the less impact expected. In cases of ties, several sites may have the same rank. Where sites differ 1 = lower impact, 2 = higher impact. This table should be used only in context; without consideration of the material presented in the text of Chapters 2 and 3 it may be misleading.

[2]These ratings refer only to the increase due to the NOAA project.

4
Summary

Two summary tables are presented to allow the reader to quickly compare the major adverse impacts for each alternative site and the mitigative measures that might reduce these impacts. Major adverse impacts are listed in Table 4-1, in this Table different symbols are used to indicate those adverse impacts that are unavoidable; those that may be reduced but not avoided, and those that can be essentially avoided by use of appropriate mitigative measures. These measures are listed in Table 4-2.

TABLE 4-1

MAJOR ADVERSE IMPACTS

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
GEOLOGY AND LANDFORMS									
Filling a large area (60 acres or more) now underwater	U				U				
Excavation and construction on steep slopes		M							
Excavation of ten acres or more of fill			U			U			
AIR QUALITY									
Increased probability of violations of sulfur dioxide standards	M				M	M			
Increased probability of violations of carbon monoxide			M						M
Possible odor problem due to disposal of organic dredge spoils	M		M	M	M	M		M	M
WATER QUALITY AND AQUATIC BIOLOGY									
Extensive dredging (more than 10 acres)		M	M	M			M		
Limited dredging (up to 10 acres)	M				M	M		M	M
Elimination of more than 20 acres of biologically productive habitat		U	U		U		U		
Maintenance dredging			M						
Increased risk of small oil spills		M		M	M	M	M		M
Significant decrease in water quality (long-term)	U								
TERRESTRIAL BIOLOGY									
Destruction of habitat					U				
AESTHETICS									
Moorage facilities on a shoreline without present commercial/industrial development		M		M			M		
ARCHEOLOGICAL/HISTORICAL									
Development in historic district							M		
Development in relatively undisturbed area with archeological potential		M							
NOISE									
Construction noise noticeably above ambient levels in a predominantly residential area		U*	U*	U*					
Operational noise noticeably above ambient levels in a predominantly residential area		U							
DEMOGRAPHY: UTIITIES: AND SERVICES									
Growth in population far greater than could be handled by existing infrastructure							U*		
Growth in population would stress some public services		M	M						
LAND USE									
Secondary impacts due to employee relocation (e.g., housing)		M					U*		
TRAFFIC AND CIRCULATION									
Five bridges opened as many as 120 times per year due to NOAA ships			U*	U*					
Three bridges opened as many as 120 times per year due to NOAA ships								U*	
One bridge opened as many as 120 times per year due to NOAA ships					U*				U*
Additional traffic congestion when bridge is nonfunctional					U				
Probable traffic generated would exceed capacity of ferry system							U		
Traffic volumes inappropriate to nature of road		M							
NAVIGATIONAL RISK									
Increased hazard of bridge ramming by NOAA vessels			U*	U*		U*			
Increased hazard for recreational boaters in Lake Washington and the Ship Canal			U*	U*					

Key:

M - Adverse impacts may be substantially avoided by measures listed in Table 4-2.
U - Unavoidable adverse impact.
* - Some mitigation possible.

TABLE 4-2

MITIGATIVE MEASURES

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
GEOLOGY AND LANDFORMS									
o Design facilities to minimize excavation and avoid destabilizing the bluff.		X							
SOILS AND EROSION									
o During construction, contain mounds of soil and rubble stored on site behind containment berms.	X		X	X					
AIR QUALITY									
o Use of low sulfur oil or engine modifications to minimize SO_2 violations.	X	X			X	X			
o Allow the SURVEYOR to leave port only when the wind is blowing out to sea or modify its engine.	X	X			X	X			
o Reduce CO emissions by encouraging car pools and staggering work hours to reduce peak hour traffic.			X						X
o Minimize odor from dredge sediments with high organic content by covering dredge spoils with a layer of soil.	X		X	X	X	X		X	X
WATER QUALITY AND AQUATIC BIOLOGY									
o Conduct all dredging behind a silt curtain to limit spreading of turbidity; monitor water quality daily at several points around the curtain.	X	X	X	X	X	X	X	X	X
o Confine dredging activities to winter months when dissolved oxygen levels in the water are generally highest and fish migration is minimal.	X	X	X	X	X	X	X	X	X
o To minimize turbidity resulting from runoff of dredge spoils, use mechanical dredges, and channel runoff into settling pond before release.	X	X	X	X	X	X	X	X	X
o To prevent near shore sedimentation caused by erosion during construction activities, employ erosion control methods such as detention and sedimentation ponds, and prompt stabilization of excavated slopes.	X	X	X	X	X	X	X	X	X
o To contain oil spills, use floating oil boom and contingency plan.	X	X	X	X	X	X	X	X	X
NOISE									
o Installation and maintenance of mufflers on all internal combusiong engine powered construction equipment.	X	X	X	X	X	X	X	X	X
o Careful scheduling of equipment to keep average noise levels low.	X	X	X	X	X	X	X	X	X
o Turn off idling equipment not scheduled for immediate use.	X	X	X	X	X	X	X	X	X
o Use vibrating-type pile drivers rather than impact pile drivers.	X	X	X	X	X	X	X	X	X

TABLE 4-2 (Cont.)

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
LAND USE									
o Plan in advance for increased population and concentrate new housing rather than allowing sprawl.		X					X		
o Adopt zoning amendments as proposed.		X							
AESTHETICS									
o High quality design and extensive landscaping.		X		X			X	X	
o Locate waterfront facilities at another site (split site).				X					
ARCHAEOLOGICAL/HISTORICAL									
o Pre-construction assessment by archaeologist.		X							
o Follow prescribed procedures (106 Hearing) for federal action affecting historic preservation district.							X		
TRANSPORTATION AND CIRCULATION									
o Avoid ship transits during peak traffic hours to minimize traffic disruption due to bridge openings.			X	X		X		X	X
o Make a dedicated effort to create car pools or van pools to help alleviate the anticipated overcrowding of ferries. Develop a park-and-ride type parking lot near the Fauntleroy Ferry Terminal.							X		
NAVIGATIONAL RISKS									
o Split-Site Alternative.				X					
o Staging pier (applicable only at Sand Point)				X					
o Limit speed of larger NOAA vessels to about 4 knots.	X	X	X	X	X	X	X	X	X
o Modify SURVEYOR by adding devices to increase maneuverability (e.g., bow thrusters).	X	X	X	X	X	X	X	X	X
o Bridge opening constraint.			X	X		X		X	X
o Familiarize new skippers with LWSC transit.			X	X				X	
o Restrictions on travel in severe weather.			X	X				X	
o Radio communication capability between vessels and bridge tenders.			X	X				X	
o Alternate berth for NOAA vessels outside of LWSC.			X	X				X	
o Determine maneuvering characteristics of larger NOAA vessels at low speeds.			X	X					
o Portage Cut									
- Larger lights at either end.			X	X					
- Traffic control for all vessels or use of advance boat when boat traffic is heavy.			X	X					
- Dredge west of entrance.			X	X					
o Mixed navigational aids in Portage Bay Reach and Union Bay Reach.			X	X					

5 Comments and Responses

A public hearing on the draft Supplemental Environmental Impact Statement (SEIS) was held on 22 and 23 August 1978. In addition, written comments were accepted through September 1978.

Comments were received from the following agencies, groups and individuals:

Federal Agencies

U.S. Department of Interior
Pacific Northwest Region

U.S. Department of Housing and Urban Development - Regional Office

U.S. Coast Guard

General Services Administration

U.S. Department of Transportation

Federal Highway Administration

Federal Aviation Administration

U.S. Environmental Protection Agency
Region X

Department of the Army, Corps of Engineers - Seattle District

Department of Agriculture
Soil Conservation Service

State Agencies and Officials

A.L. Rasmussen, Senator

John R. Hogness, President, University of Washington

Department of Game

Slade Gorton, Attorney General

Department of Ecology

Parks and Recreation Commission

Department of Transportation

Regional and County

Puget Sound Air Pollution Control Agency

Puget Sound Council of Governments

Municipality of Metropoiltan, Seattle (METRO)

John P. Spellman, King County Executive

City Officials

Beaux Arts Village, Harold Kunkle, Mayor

Seattle City Council, John Miller, President

City of Seattle, Charles Royer, Mayor

Town of Hunts Point, J. W. Barton, Mayor

City of Kirkland, Allen B. Locke, City Manager

City of Mercer Island, Ben J. Werner, Mayor

Seattle City Council, Jeanette Williams

Port of Everett, John Martinis, Commissioner

Port of Tacoma, Richard D. Smith, Executive Director

Port of Seattle, Meryle Adlum, Commissioner

City of Tacoma, Mike Parker, Mayor

Seattle Board of Park Commissioners, Thos. O. Wimmer, Chairman

City of Bellevue, W. H. Parness, City Manager

Michael Hildt, Seattle City Council

George Benson, Seattle City Council

Severo Esquivel, Acting City Manager, Tacoma

Port of Everett, John Belford, Executive Director

Organizations

Magnolia Community

Seattle Shorelines Coalition, Rita Griffith

Save Lake Washington, Dorothy Harsch, Administrator

Oceanographic Commission of Washington, Glen Ledbetter, Executive Secretary

Transportation Institute, Bill Lawrence, Manager

Washington Environmental Council

Bellevue Coalition of Community Clubs, Maria Can, President

Laurelhurst Community Club, Gail B. Hofeditz, President

The Sea Use Council, Adm. E. D. Stanley, Jr., USN (Ret)

View Ridge Community Club, Inc. John R. George, President

Mt. Baker Community Club, Donna James, President

Norwegian Commercial Club, Knut Lindberg, President

King County Economic Development Council Bill Ostensen, Executive Director

Economic Development Council of Puget Sound, Robert Buck, Chairman

Puyallup Tribe of Indians, John Clinebell, Tribal Attorney

Shorelines Committee, Queen Anne Community Council, James T. Smith, Chairman

Mountlake Community Club, Doris Burns, President

Tacoma Area Chamber of Commerce, Lester M. Bona, President

Individuals

Don G. Abel
Merle D. Adlum
Thomas E. Allen
William R. Anderson
Franklin Badgely
Robert I. Barto
John R. Beck
Pete Bement
George E. Benson
Charles R. Benton
Estelle & Irving Berteig
Alice Blackstock
Beverly & David Bodansky
Louise & Paul Bonin
Stan Boreson
James & Ina Bray
Natalie Briggs
R. A. Brown
Mrs. William A. Browning
Dr. Robert A. Bruce
William Bryant
William T. Burke
Jean Burling
Clarence H. Campbell
Benella Caminiti
William S. Chalk
James D. Chalupnik
Stephanie D. Chandler
Robert J. Charlson
Norton Clapp
Dr. & Mrs. David Cohen
Kenneth B. Colman
Marie Cowan
Samuel J. Cowan
Lowell L. Cox
C. T. Crane
Dennis E. Dahlgard
Joanne Davis
Capt. W. F. Dawson, USN (Ret.)
Ernest W. Dearborn
Samuel DeMoss
Josef Diamond
Edmund D. Dickey
Dorothy & Ito Diluck
Helen Dorman
Barbara Droker
Roger E. Dunham
Alyn C. Duxbury
Robert G. Eade
Mrs. Walter Eichinger
C. G. Evans
Charles Finkle
Earl P. & Isabel M. Finney
Jack N. & Anne Fisher
Robert G. Fleagle
Joseph M. & Frances J. Forde
Ana Marie Freund
Felix G. Freund
Martha Freund
Pia & Georgette Friedrich
K. V. Greggerson
Walter E. Griffin
Avery M. Guest
Virginia Gunby
Charles & Alice Gustafson
Murray Guterson
Dayee G. Haas
Donald T. Hall
Marion S. Hamilton
Thomas L. Hankins
Alfred Harsch
Dorothy Harsch
R. L. Hass
Kate W. Hemer
Dorothy & Dwight Henderson
Edward B. Henderson

Spencer M. Higley
C. F. Hilgeford
Raymond G. & Ruth M. Hill
Merrill B. Hillaugh
J. G. Thwing & Robert Hitchman
Laurie & Preston Hobart
Stanley & Phyllis Honeywell
Ruth Horsley & Bob Horsely
Myron S. Huckle
Ed Hufford
A. E. Hunt
Demar Irvine
George B. Jardner
Ralph Jenkins
Rod K. Johnson
Lucile Jones
Mae W. Kemp
William S. Kemp
John W. Kennedy
Don Ketterman
Patricia C. Hiefer
Charles Kindt
Robert L. & Phoebe King
Louise B. Klug
Harold F. Knob, Jr.
Edward W. Kuhrau
Herbert Laband
Mrs. Howard LeClair
Roger M. Leed
Eleanor & Robert Leithead
Louise C. Leson
Nicholas Licata
W. M. Liddle
R. A. Lininger
Edity A. Lobe
Paul W. Locke
F. C. Lulls
Edwin T. MacCamy
Harold & Eileen Mansfield
Galen H. Maxfield
Alfred R. McCausland
Jame McClelland
Ruth and Warren McCloy
Dorothy McCormick
Wells B. McCurdy
Mark N. McDermott
Leonard & Verna McDowell
Pamela McKenna
Donald T. McKernan
Barry W. McLean
Will McPeak
Clarice L. Messer
Tom Miller
Leonard E. Miller
Peter and Nicoletta Misch
William J. Montgomery
Russ Van Moppes
James H. & K. L. Morison
Russell T. Mowry
Ted Mullendorff
Mr. & Mrs. Charles R. Nelson
Mildred G. Nelson
Marshall T. Newman
Clayton T. Noonan, MD
Gayle Nordlund
Ernest A. Norehad, MD
Gunnar Olsborg
James L. Olson
Judith O. Opacki
Elizabeth Ostin
Elizabeth C. Padvorac
N. R. Padvorac
Theresa Ann Padvorac
Genevieve Parker
Patrick J. Parker
Ann Paclayan
Robert L. Phelps
Richard C. Philbrick
Lucile Pistole
Mr. & Mrs. C. W. Pleis
Kay Regan
Carol Richman
Betty W. Rieke
Robert D. Robertson
William F. Royce
ADM. James S. Russell, USN (Ret.)
Bernard S. Sadowski
Wayne & Ann Sandstrom
Richard Sandiss
H. S. Sanford
F. H. Schmidt
Mrs. Karen Schurr
H. L. Schuyler
Foss Launch & Tug Co., Steve Sealzo
H. D. Selby
Helga Selmer
Henry Shain
Marion L. Shaw
Elizabeth V. Sherris
Martha Gardney Sick
Donald R. Silverman
David E. Skinner

Ben J. Smith
Ben J. Smith, Jr.
Doris M. Smith
Merrill P. Spencer
Harold L. Spiess
Harold E. Stack
Herbert L. Stevenson
W. G. Stewart
Merrill M. Stover
Inge Strauss
Stephen Sulzbacher
A. P. Summy
Betty J. Suttora
Gordon H. Sweaney
Jack G. Sweek
Fred & Jean Thieme
Melda Thompson
Terry Thompson
Muriel S. Thruber
Mrs. Alice L. Trier
P. C. Van Soelen
G. W. Van Winkle
Inge Vargas-Baron, Anabelle Vargas-Baron, Robert R. Vargas
Marguerite & Nicholas Vincent
William & Helda Vogl
Ruth S. Voiland
L. Wesley & Marylou Wager
David E. Walker
Arnie T. Warsinske
Charles F. Weil
Lucille S. Wilkins
J. L. Williams
Bill Wilson
Helen B. Winter
Mrs. Thomas C. Winter
Beatrice Yarneau
Karen Jo York
Clayton Young

Due to the fact that such a large number of comments were received, the points raised were summarized for inclusion in the final SEIS. The comments are divided into two major categories: those that raise technical questions and those that address NOAA policy. The technical comments are further grouped according to the issues raised. The categories used are: general, site selection, air quality, water quality and aquatic biology, terrestrial biology, archaeological and historical resources, noise, economic forces, land use, utilities and energy, transportation and circulation, and navigational risk. These categories parallel those used in the main body of the SEIS.

TECHNICAL QUESTIONS

GENERAL

B. McClean

Comment: The SEIS needs a glossary, an index, a classification system, and a summary of each section.

Response: The SEIS is not intended to be a reference document; therefore, index, glossary and classification system were not included. Summaries are included as appropriate.

NOAA (J. Watkins)

Comment: Tables 3-1 through 3-4 include navigational risk as one of the seventeen environmental elements. These tables are prefaced by a comment made on page 3-8, "Adverse impact on each environmental element associated with development at each of the alternative sites ....". The reader would assume in reviewing these tables that those impacts shown for navigational risk are caused by a NOAA development. Actually the risks are preexisting

and would be experienced by any boat operator proceeding to the various locations.

A distinction should be made between navigation risk and the other environmental elements shown in the tables, or only the adverse impact caused by NOAA development on navigational risk should be shown.

Response: We concur. Tables 3-1 and 3-4 have been changed to reflect only the adverse impact attributable to NOAA development.

A. Duxbury

Comment: The ratings and rankings in Tables 3-1 to 3-4 appear to be arbitrary and not based on fixed standards. Rankings should not be based on someone's interpretation of the present conditions. In particular, ratings (Table 3-1) of impacts on terrestrial biology, navigational risk and air quality seem unjustified, as do rankings (Table 3-3) of sites with respect to impact on navigational risk and aesthetics.

Response: Discussion prior to the Tables has been expanded to clarify their purpose and meaning; notes have also been added to the Tables. An assessment of this kind must necessarily depend on the professional opinions of experts in the various disciplines. The impact of a proposal on most environmental elements cannot be evaluated without considering the context provided by existing conditions.

Adverse impacts on terrestrial biology are rated as moderate at Sand Point because portions of the site are used by a variety of birds and limited similar habitat is available nearby. In contrast, Kenmore has little vegetation and more attractive habitat is available near the site; similarly, at Manchester, ample quantities of attractive habitat are available nearby.

Ratings and rankings of navigational risk have been adjusted, as discussed in the response to the previous comment. Ratings of air quality are based on a combination of impact of the project per se and interaction with existing levels. We consider this to be a valid approach. Ranking of aesthestic impacts are based on the number of people who would see the facility or have their present views obstructed.

U. S. General Services Administration

Comment: Page 2-15, Aesthetics. The statement that the NOAA facility at Everett would change the appearance to "one of landscaped campus" of the site is prejudging the A/E design of the buildings and site.

Response: An integral part of the plans for a Western Regional Center is the provision for extensive landscaping in an open site design to provide a visually appealing development. This would apply to all sites under consideration.

Comment: Page 3-9, Section 3. No action alternative. The last sentence of the last paragraph is not a true statement. The detailed functional program documents have shown that most of the MLCs will be impacted in their operation and future programs if no action is taken. A more thorough discussion of this alternative would be advisable.

Response: The sentence referred to deals with the inability to

assess environmental impacts of expanding current operations in additional leased space without knowing which activities would expand, where they would expand, or the type of facilities that would be required. The detailed program for the Western Regional Center does not contain information on the environmental impact of no action. The discussion of this alternative has been expanded.

Puget Sound Council of Governments

Comment: The Puget Sound Council of Governments has reviewed the draft Supplemental Environmental Impact Statement and by Executive Board Action of September 29, 1978 has determined that it has no comments to offer.

Response: Acknowledged.

C. Hilgeford

Comment: What are the costs of mitigating measures proposed for use at Sand Point?

Response: A detailed analysis of costs of mitigating measures at the various sites is not possible. Some of the measures could be implemented by NOAA jointly with another agency while some could only be accomplished by agencies other than NOAA. That agency along would determine the extent to which a particular measure would be implemented. To the extent that NOAA has authority to implement mitigating measures, corresponding costs of those measures incorporated will be included as part of the total project cost submitted for Congressional action.

R. Leed

Comment: What impacts would expansion of NOAA facilities at Sand Point over the next 20 years have on water traffic, street traffic, housing requirements, and air, water, visual and noise pollution?

Response: The analyses of impacts for all sites, provided in Chapter 2, is based on the ultimate projected population (2300 employees), with three exceptions: Vehicular traffic, and noise and air pollution due to vehicles. Analyses of these factors were based on 5-year projections and the population at the onset of operations because 20 year traffic projections are so unreliable that meaningful comparisons of impacts at the various sites would not be based on these projections. Additional analysis of impacts at Sand Point is contained in the FEIS (NOAA, 1976).

D. Harsch

Comment: The Supplemental Environmental Impact Statement makes no reference to the poll of Seattle citizens conducted by the Seattle Chamber of Commerce. I suggest that the results of the poll be included in the final draft.

Response: Seattle Business, a Seattle magazine published by the Seattle Chamber of Commerce, asked their readers for their views on NOAA's plans for Sand Point. Approximately 100 readers responded with comments which were summarized in two subsequent articles. According to the editor, their request was in no way meant to be a poll of Seattle citizens. Three-fourths of the respondents opposed the project.

J. Russell

Comment: Berthing at Sand Point will add pollution to a residential area including noise, air, water.

Response: The environmental impacts and mitigative measures for a NOAA facility at Sand Point are discussed in Chapter 2 beginning on page 2-46.

K. Greggerson

Comment: No clear-cut handle is given on how many NOAA ships and how many piers nor their lengths are going to be required.

Response: One criterion used to screen potential alternative sites was that the site must provide moorage space to accommodate 12 reasearch and hydrographic vessels. A list of 10 NOAA vessels which will be berthed at the facility is shown on page A-93 in the Draft Supplemental EIS. The actual number of piers and their lengths differ considerably between sites to take into account the amount of shoreline available, depth of water, exposure to weather, and vessel maneuvering room. Pier plans developed for Sand Point include four large piers and three smaller piers as shown below:

2 piers at 470'	2 piers of 130'
1 pier at 380'	1 pier of 40'
1 pier at 370'	

The purpose of the four larger piers is to provide moorage for the 12 NOAA vessels. Smaller piers will be used to dock hydrographic launches and smaller reconnaissance craft.

D. Harsch

Comment: What are the activities that will be carried on at the split-site location, number of employees, square footage of space, hours of operation, materials including toxic chemicals, waste products produced and discharged.

Response: Criteria for Waterfront Portion of Split Site are listed on Pages 1-9 in the Draft Supplemental EIS. The Final Environmental Impact Statement described the pier activities on Page 16. The regular hours of operation are typical for most government agencies, 8:00 a.m. to 4:30 p.m. Routine repairs, modifications, and servicing are included in Appendix H in the Draft Supplemental EIS.

C. Hilgeford

Comment: Is it true that the current estimate of the cost of dredging and pier construction is now in the neighborhood of $18M?

Response: The current estimate in 1978 dollars for dredging and pier construction at Sand Point is approximately $6M.

K. Greggerson

Comment: No mention is made in the supplemental EIS about the type of pier pilings used to construct the piers.

Response: The subject of pier construction is discussed in the FEIS, Page 12. Reinforced concrete piling and pier surfaces are planned for Sand Point.

J. McClelland

Comment: We are concerned about the growth of NOAA once at Sand Point.

Response: It is the position of the NOAA Administrator that expansion beyond the amount shown in tentative Sand Point development plans (36%) would be unwise and that extending or adding longer piers for the larger vessels at Sand Point would not be approved. The maximum NOAA population would not exceed an estimated 2,300 people. Any significant change in NOAA's plans, including facility or personnel expansion, could not be done without the consent of the Congress, regardless of location.

P. Bement
R. Phelps

Comment: Draft SEIS should discuss the added transportation costs as the result of development of the Sand Point site versus maintaining the oceangoing vessels at the present location.

Response: Based on a maximum of 120 ship transits per year, the additional cost would be approximately $16,500 annually. This amount includes personnel and fuel costs.

C. Hilgeford

Comment: What is the cost of cancelling the current lease at Lake Union-PMC? Will the General Services Administration do the contracting for any and all construction?

Response: As the government lessee, the General Services Administration (GSA) is currently leasing the property used by NOAA as its Pacific Marine Center on Lake Union. GSA does not anticipate the government having to pay any cost in cancelling the lease should NOAA decide to vacate the property. (This anticipation is based on the current high market demand for fresh water shoreline properties.) Under a memorandum of understanding GSA is responsible for handling all design and construction contract activities toward development of a NOAA Western Regional Center.

H. Stack

Comment: I am extremely concerned about the junkyard atmosphere that we see at NOAA's operation right now that would be transplanted to Lake Washington.

Response: One small area adjacent to the present NOAA warehouse at the Lake Union PMC site is currently being used as an outdoor storage area for ships' equipment and experimental hardware. All other storage is in covered warehouse space. The plans for the proposed new facility will provide adequate indoor covered areas for the operation and storage of equipment for the NOAA ships.

B. Yarneau

Comment: With the anticipated cost of Lake Washington dredging at Sand Point of $2.5M and $3.5M for piers, how would this compare with the cost of mooring the NOAA ships at Piers 90 and 91 where no dredging would be necessary and with only possible repairs to the piers and buildings?

Response: Determining accurate costs for acquiring and developing Piers 90-91 to meet NOAA needs would require a considerable commitment of resources. Preliminary engineering

would be required including surveys of existing piers and buildings, concept designs for new structures, soil borings, and demolition or renovation of inadequate facilities. These studies would result in a tentative development cost for budgetary purposes. This cost must be added to property acquisition and time-delay expenses. Property acquisition is estimated to be over $20M in today's market. (According to GSA, the appraised value in 1974 when the property was sold to the Port of Seattle was approximately $15.4M). Since the Port has indicated on several occasions that Piers 90-91 are not available, we believe determining accurate cost information for developing this area would be a poor use of public funds. (See page 5-19 for responses to similar comments.)

D. Harsch

Comment: Structural repairs and modifications included in Appendix H do not constitute minor repairs. Such repairs can only be classified as industrial-type operations.

Response: Whether or not the maintenance activities that would occur at the NOAA facility can only be classified as industrial operations is a matter of opinion. The Seattle Department of Community Development has reviewed NOAA's plans for developing a portion of the Sand Point site and has determined that the proposed development and its operation, when conducted and mitigated as described in the Final EIS, is consistent with the Seattle Shoreline Master Program.

Montlake Community Club
D. Burns, President

Comment: What is the exact relationship between NOAA and the University of Washington? Is there duplication of NOAA facilities and the proposed eight marine sciences buildings on campus? How does NOAA employ the University's computer facility and what relationship does that use have with the request for another U.W. computer building?

Response: NOAA has a close working relationship with several departments of the University. Twenty-one NOAA scientists hold positions with the University as affiliate faculty members and occasionally teach various graduate-level courses. There is also active NOAA involvement in the University's various graduate study programs. For further information, see "Operational Considerations for Site Selection for a Western Regional Center" as referenced in the SEIS.

In early 1977, NOAA reviewed preliminary plans for the U. of Washington Marine Studies Facilities and met with University personnel to assure that there would be no duplication of planned facilities. NOAA employees use the University Academic Computer Center quite frequently; however, this usage by NOAA has no relationship with the request for another U.W. computer building.

SITE SELECTION

B. Smith

Comment: Why was the possibility of taking over the Lake Washington Shipyard not investigated?

Response: The Lake Washington Shipyard has been out of business for many years. The area is currently being used for commercial and recreational activities. No other

property in that area has been identified as available for NOAA's consideration.

H. Spiess

Comment: Could a portion of Fort Lawton be used for the Western Regional Center?

Response: Site 14 in Tables 1-1 to 1-5 includes the only portion of Fort Lawton identified as available, this parcel was too small. Most of the remaining portion of Fort Lawton is now being developed by the City of Seattle.

State Parks Department

Comment: Our only comment is to reiterate the State Parks Department's previous position of resisting any action by NOAA to acquire State Park land at Manchester by condemnation.

Response: The property being considered at Manchester as an alternative site is currently NOAA-owned.

R. Dunham

Comment: Does NOAA intend to close down its NMFS Service located at 2725 Montlake Blvd.? If not, how can it be stated that the purpose of the project is to consolidate?

Response: In the early stages of facility planning, NOAA made the decision to retain the buildings located at Montlake. This decision was based on several factors including the unique characteristics of the laboratory buildings designed especially for fishery research needs, its immediate proximity to the University of Washington, and the fact that the facilities are already NOAA-owned. For these reasons, the Montlake laboratory was never included in the plans to consolidate other NOAA units at a Western Regional Center.

R. Lininger

Comment: NOAA has made a determination that sites requiring acquisition by condemnation are excluded from further consideration. To expect that the federal government may have to condemn land to carry out a public project is reasonable and supportable by similar actions carried out by your own agency and others of the federal government. By establishing this criterion, you conveniently eliminate Piers 90-91, which otherwise totally meet your requirements.

Response: Although there is no federal priority in acquiring land, NOAA and other federal agencies consider condemnation as a last resort which is used only when absolutely necessary where no other reasonable alternatives are available. The process is lengthy and because it often involves court action, it is generally unpopular. Condemnation can add a year's delay to the land acquisition process. In cases where there is an established business on the property, the government is responsible for paying business relocation reimbursements to all occupants. For these reasons, consideration of property owned by NOAA or available for sale is entirely justified in the public interest.

W. G. Stewart

Comment:

a. Who are the 21 scientists who hold positions at the University?
b. What is their salary from NOAA?
c. What is their salary from the University?
d. What grants do they work under in addition?
e. Who are the 75 scientists who visit the University more than 80 times each week?
f. What are their salaries from NOAA?
g. What are their salaries from the University?
h. What grants do they work under?
i. How much does NOAA pay for the 16 contracts at the University?
j. What are the contracts for?
K. Has NOAA tried to obtain these services through the private business sector?
l. Has NOAA considered the possibility of locating their facility on the University of Washington campus as part of the new Oceanographics and Atmospheric construction which is taking place?

Response: The scientists holding positions at the University are research scientists employed by the Pacific Marine Environmental Laboratory, the Northwest and Alaska Fisheries Center, and the Northwest Regional Office of the National Marine Fisheries Service. Several are Senior Fellows of the Joint Institute for Study of Atmosphere and Ocean (JISAO), a cooperative research unit with the University. Others hold faculty positions or teach courses and seminars occasionally. None receive financial compensation from the University for their services. All are government salaried employees. The 75 scientists who visit the University more than 80 times each week are these same scientists plus those who use the computer, technical services, and library facilities at the University. Again, none of these scientists receive any salary from the University.

NOAA provides grants to the University for research and teaching. The University in turn shares its resources (services), data, and findings.

NOAA pays the University approximately $1.2M for a total of 16 contracts for research, computer, and technical services. NOAA has advertised these needs for competitive contracting and does utilize private enterprise when economically advantageous (e.g., Superior Reprographics for photo and duplication services).

The PMEL has investigated the possibility of locating its facility on the University of Washington campus; however, the University is unable at this time even to provide for needed expansion of its own facilities (e.g., Applied Physics Laboratory) and is therefore in no position to provide additional spaces for a separate entity such as NOAA.

J. McClelland

Comment: In reference to the Management Report on the 60-minute driving time from Seattle, how are the television briefings done? How often? What is sold at the convenient sales offices? Is NOAA personnel directly running the store? What coordinating of marketable fisheries products is done? How often? Could some of these services be provided by telephone? Could private enterprise be used?

Response: The TV briefings are conducted via personal visits by the three major TV station weathermen to the Forecast Office. These briefings must be accomplished in person, as the weathermen need to review maps and satellite photos. The radio stations pick up NWS reports via a teletype system. Nautical and aeronautical charts and related publications are sold at the sales office located at the PMC. NOAA personnel manage the office, which is also a contact point for obtaining survey data. National Marine Fisheries Services reporters visit the Seattle waterfront daily to gather information from Seattle fishermen on current prices, quantity of landings, amount of imports and exports, and other information of importance to fish product wholesalers and processors. This information is published in the Fisheries Market News three times a week and distributed to 900 subscribers. The information on fish landings must be collected in person on the waterfront.

Public dissemination of these types of information and service are part of NOAA's mandated mission.

Comment: We request that a complete study of the proposed University facilities be undertaken prior to the final EIS.

Response: No facilities for the University of Washington are being planned for the proposed Western Regional Center. A study of proposed University facilities by NOAA is considered inappropriate.

A. Duxbury

Comment: I believe it should be pointed out to the public, what are the real costs to them associated with having to maintain piers and vessels, and to construct facilities at a salt-water site versus a fresh-water site.

Response: The cost difference to maintain and operate piers and vessels in fresh water versus salt water is an operational factor. Barnacles and marine borers do not grow in freshwater, thereby eliminating the need for their removal and for the constant maintenance of fender piles. In fresh-water, tidal variations are absent, eliminating certain problems with line handling and fender protection. Also, corrosion is considerably slower in fresh water. Construction costs of overwater facilities in water with a constant level (such as a controlled lake) is estimated to be 10-20% less than in tidal water. Dredging depth and pier height are increased in tidal areas and batten piles are more expensive to place becuse of the changing tide.

B. Yarneau

Comment: There is no precise information on the extent to which NOAA operations are tied to the University of Washington or the extent to which mutual efforts depend on current proposed development of marine sciences buildings and programs of the University of Washington.

Response: The referenced report "Operational Considerations for Site Selection of a Western Regional Center" provides a description of important professional interrelationships between NOAA and the University of Washington (Page 29). NOAA is not contributing any resources to the University of Washington for their development of a Marine

Sciences Center. The anticipated effect of such a Center will be a beneficial exchange of information between government and University scientists which would be useful in carrying out their respective research studies.

Comment: Is there any necessity of having the piers near the University of Washington?

Response: There are no proximity requirements for the University of Washington personnel to be near the NOAA ship berthing facilities. NOAA proximity requirements are for the Western Regional Center to be within a 60-minute distance from the U. of W. and the NMFS Montlake Laboratories, and for ship berthing facilities to be within a 30-minute distance from the remainder of the Regional Center.

Magnolia Community

Comment: We the undersigned residents of the Magnolia District of Seattle, Washington strongly urge NOAA to immediately confer with City Port Commission with respect to the availability of Piers 90-91, and if the site is now available, to seriously consider it as a possible alternative site either as a consolidated or split site for its Western Regional Center. (Petition signed by 218 residents.)

Response: NOAA has contacted the Port of Seattle on several occasions to discuss the availability of Piers 90-91. The Port maintains that it has no interest in the federal government developing any portion of Port property. See the following response to comment by D. Harsch.

D. Harsch
B. Yarneau
R. Van Moppes
Save Lake Washington
Beaux Arts Village

Comment: Why weren't Piers 90-91 considered as an alternative site for NOAA?

Response: Piers 90-91 was one of five alternative sites NOAA originally considered for development of a Western Regional Center. (See Final Environmental Impact Statement, Pages 6-10). The results of a comparative site study contained in the FEIS showed that Piers 90-91 ranked the lowest in terms of utility and third in terms of utility to site costs. These piers were again identified as a potential consolidated or split-site location in the Supplemental EIS. However, in 1976 the Port of Seattle acquired the piers and has since developed the area for import auto loading and processing, and other general cargo operations. The Port has indicated that their operations use the entire area and will continue to do so in the foreseeable future and that it would not be available for NOAA's use. They were unable to suggest any sites for consideration. Contact as recent as October 3, 1978 revealed that nothing has changed to cause the Port to reconsider their previous position.

R. Bruce

Comment: If proximity of NOAA to the University of Washington Marine Sciences is important, how is the additional two miles distance to Sand Point (4.5 miles to Sand Point vs. 2.5 miles to Lake Union) justified?

J. Smith, Chairman
Shorelines Committee
Queen Anne Community Council

Comment: Our reading of the SEIS reinforces our long-held frequently expressed opinion that the P-90/91 site (Piers 90-91) is an ideal location for the NOAA Western Regional Center. We feel that the site possesses all of the required attributes for serious consideration and several of significance not shared by the Sand Point site.

Response: The opinion of the Queen Anne Community Council is acknowledged. However, the piers are presently owned by the Port of Seattle which has developed long-termed plans for continued use. Since this property is not available to the government, it has not been considered as a viable alternative site in this impact statement.

W. Stewart

Comment: How was the distance criteria of a 60-minute driving time arrived at?

Response: A questionnaire was sent to each of the NOAA units that have professional relationships with the University of Washington, the Northwest & Alaska Fisheries Center, and primary NOAA user groups (public) to define both the optimal and acceptable driving distances between the respective offices. The results indicated, on an average, an optimal distance of 10 minutes and an acceptable distance of 30 minutes. The distance criterion of 60 minutes (twice that considered acceptable) used to screen potential sites is considered generous.

Comment: How was the distance criteria of 30 minutes driving distance for split sites to Sand Point derived?

Response: The approximate driving time between the two furthest NOAA locations that are planned for the Western Region Center is estimated at 30 minutes. The time distance was selected as a screening criterion since consideration of sites beyond this distance would represent a worsening of NOAA's present physical condition.

AIR QUALITY

J. McClelland

Comment: The number of citations and fines for smoke pollution from NOAA vessels should be considered.

Response: As discussed on page 2-82 of the draft SEIS, NOAA ships have been cited five times since 1969 and one fine has been imposed.

City of Tacoma
M. Parker, Mayor

Comment: Although the port industrial area in Tacoma is a non-attainment area for suspended particulates, violations of air quality standards have been very rare; therefore both Hylebos sites, in terms of air quality, are just as representative as the majority of the other sites considered and should, therefore, be evaluated accordingly. Furthermore, since ships are not considered by EPA to be one of the twenty-five or so major categories of air pollution,

the Puget Sound Air Pollution Control Agency has informed us that, in their enforcement capacity, they cannot foresee at any time having to restrict vessel departures even during periods of stagnation.

Response: The comparison of sites is necessarily relative; although rare, violations at the Hylebos sites are more frequent than at many of the other sites. In addition, the location of the sites and the monitoring station is such that emissions from the ships are more likely to contribute to violations than at other sites.

A. Hunt

Comment: Influence of a 2 to 6 hour engine run during stagnation periods should be evaluated.

Response: The air quality impact analyses examined the effect of superimposing emissions during this engine run period on the maximum levels observed at the nearest monitoring station. (See Appendix C.)

J. Forde

Comment: The mitigating measures proposed for ships suggest that the ships emissions would have a major impact on the environment. What has been happening to areas in which NOAA ships now operate?

Response: The existing air quality conditions at Lake Union, where ships now operate, is discussed on pages 2-79 and 2-82 of the draft SEIS. The nature of the mitigative measures proposed may tend to mislead readers as to the severity of the air quality impacts; these impacts would have virtually no regional significance.

Puget Sound Air Pollution Control Agency

Comment: The statement that "air quality in the Puget Sound Area is generally quite good" should be qualified since the air in this region does require improvement.

Response: The regional air quality discussion has been amended to reflect the non-attainment status of the region.

Comment: If it will be necessary to operate the ships' boilers/engines for substantial periods of time, NOAA should consider require shifting to lower sulfur-distillate oil.

Response: Ships engines are operated only when preparing to depart; while ships are docked, shore-supplied power is used. Shifting to lower sulfur oil is suggested as a possible measure to mitigate the SO_2 impact.

Comment: Conditions assumed in the departure scenario include "no emissions occur in port upon return from sea." It would be highly desirable if soot blowing on the steam vessel can be restricted as much as possible while in port. In past years this often has been the final act, performed by the fireman on watch after the ship has tied up in port, immediately prior to securing engines and boilers. Such a practice is reprehensible since it often directs a large cloud of soot particles toward nearby residential areas. We recommend that "no emissions upon return" be made a standard operating procedure.

Response: The regional discussion has been amended to include this recommendation as a proposed mitigative measure.

Comment: The prediction of a 1-hour carbon monoxide violation (36.6 ppm) and a 7.7, 8-hour average (not a violation) is, as you state, "anomalous" indeed. For this to happen, the 36.6 ppm average will need to drop to 3.5 ppm for the remaining 7 hours, which is an unrealistic swing for a state highway.

Response: The apparent discrepancy between the measured and predicted ratio of the 1-hr to 8-hr maximum concentration level is explained by considering the assumptions underlying the concentration estimates. For the worst case 1-hr maximum, the traffic speed is assumed to be 10 mph under F-stability with a wind speed of 1 m/sec parallel to the roadway. These conditions appear to be realistic for times during the year when traffic conjestion may occur simultaneously with atmospheric stagnation. The esimate is quite conservative, however, since the wind speed under these conditions is generally higher than the value of 1 m/sec used in the calculations.

The 8-hr average was calculated by assuming that the stable meterological conditions used to calculate the 1-hr maximum persist for 8 hours. For the 8-hr average case, however, the average vehicle speed on the roadway was assumed equal to the posted speed limit. For the case of Kenmore (SR 522), the posted speed limit is 40 mph, which represents a four-fold increase in vehicle speed compared to the worst-case 1-hr projection. Due to the strong inverse relationship between vehicle speed and vehicle emissions on a mass of emissions per mile basis, the calculations indicate a considerable discrepancy between the ratio of peak 8-hr to 1-hr concentrations and measured values. The apparent problem lies in the facit assumption that the 4-hr and 8-hr conditions are mutually exclusive. Under actual conditions, the occurrence of high 1-hr concentrations usually implies high 8-hr average concentration. Furthermore, the assumption of a vehicle speed of 10 mph for 1-hr will directly influence the average vehicle speed for the 8-hr period. However, for simplicity, the analysis presented did not address the case in which the maximum 1-hr average period was inclusive in the 8-hr average. If such considerations had been considered, the predicted 8-hr averages would have been on the order of 0.5-0.6 of the maximum 1-hr values for most cases.

U.S. Environmental Protection Agency

Comment: We are rating the supplemental draft EIS LO-2 (LO-Lack of Objections, 2-Inadequate Information). This rating and the date of our comments will be published in the Federal Register in accordance with our responsibilities to inform the public of our views on proposed Federal actions under Section 302 of the Clean Air Act as amended.

Two principal areas where there is inadequate information are as follows: Although air quality impact projections are made on the environmental statement neither the statement nor its appendices indicate what methodologies were used to make the projections or what key assumption were used in those projections. Without that information we cannot

determine whether the forecasts are reasonably accurate. We suggest that Appendix C be expanded to include such a discussion. This expansion should also include whether the most current edition of EPA's Motor Vehicle Emission Factors Document was used in the analysis.

The second objection is considered under Policy Questions.

Response: Appendix C has been expanded as suggested.

WATER QUALITY AND AQUATIC BIOLOGY

A. Hunt

Comment: Routine maintenance will generate heavy particles that will sink, causing a decrease in oxygen content at the bottom of the lake.

Response: Particles generated by routine maintenance activities will be principally inorganic and would not reduce oxygen content of bottom waters.

M. Cowan

Comment: What effects will dredging at Sand Point have on the benthic invertebrates described on Page 2-42?

Response: These impacts are discussed on Page 2-48 of the SEIS.

Port of Tacoma, Richard D. Smith

Comment: Discussion of existing conditions for the Hylebos sites does not draw on the "Biological Baseline Study for the Proposed Marine Terminal at Hylebos Waterway" (Northwest Environmental Consultants, October 1973).

Response: The cited biological baseline study is in fact the same report as that cited in the study. This study was included with minor changes, as an appendix to two different EISs.

U. S. Department of Interior
Pacific Northwest Region

Comment: Impacts on water quality as a result of the routine chipping and repainting that occur on the docks when the ships are in port should be discussed for all alternative sites.

Response: These impacts differ little from site to site; therefore, a general discussion applicable to all sites is included in the section on "The Overall Puget Sound Region" (Page 2-5).

Comment: We feel some information needs to be added to the section on adverse impacts of dredging at the Sand Point site. We are concerned about protecting the remaining littoral zone of Lake Washington. This shallow water zone, which is only 5% of the total lake area, is of primary importance for the protection of algae, plants, invertebrates and fish.

Response: The Water Quality and Aquatic Biology section for Sand Point has been expanded to emphasize the importance of the littoral region.

Comment: The increase in spiny ray fishes referred to on page 2-48 may result in further depletions of sockeye salmon as a result of increased predation.

Response: The discussion has been amended to include this impact.

Comment: There is some finite risk, however small, of a freshwater oil spill as a result of the presence of NOAA ships. The final statement should address the potential impacts of spills of various magnitudes and various sizes and should also contain an oil spill contingency plan.

Response: The possibility of an oil spill is addressed in Appendix A. Impacts would vary greatly, depending on factors such as spill size, location, and weather conditions. An oil spill contingency plan for the PMC facilities in Lake Union has been developed and would be reviewed and revised as necessary for a facility at Sand Point.

Comment: We wish to reaffirm the importance of the North Hylebos site as a productive area for benthic organisms eaten by juvenile pink and chum salmon.

Response: Acknowledged.

State of Washington Department of Game

Comment: We doubt that spiny-ray habitat would be increased by the facilities especially if they were located in areas with heavy vegetation such as Kenmore or Manchester.

Response: The discussion has been modified to reflect this comment.

Comment: The major problem we see with locating the facility in Everett would be the precedent-setting nature of placing 80 acres of fill in a saltwater area. This is especially critical due to the close proximity of the environmentally sensitive Snohomish River Estuary.

Response: This impact has been added to those discussed.

Comment: More information about fish in Hylebos Creek should be added, and conclusions about probable water quality impacts at South Hylebos should be qualified.

Response: The discussion has been modified to reflect the comment.

Comment: We question the statement that "the proposed facility would have only minor impacts on water quality" if it were placed at Manchester. The dredging and long-term operation of the facility could create a distinct reduction in the water quality of this area.

Response: Although detailed studies would be required to provide a definitive answer to this question, available data on the tidal circulation in Clam Bay indicate that runoff from the site and ships, maintenance activity and other expected activities would have little impact on long-term water quality.

Comment: Would you explain why you would expect water quality impacts from 800,000 cubic yards of fill at North Hylebos to be minimal?

Response: The fill is not expected to significantly affect circulation in the area; therefore, no long-term changes in water quality are expected. Some short-term turbidity, increased heavy metal concentrations, and related impacts may occur during addition of the fill; however, if dredge spoils

removed by clam shell dredge are used, little turbidity would be expected. The short-term impacts will also vary with the season as mentioned in the discussion.

Comment: Dredging can release sulfides and heavy metals, as well as increase turbidity. These can create serious problems for fish, especially fry. Impacts depend on many variables including the size of particles to be dredged. It may be inaccurate to state "these toxicants are not biologically active and are removed from the water as the sediment re-settles."

Response: Sulfides are a potential problem only where sediments contain high levels of organic material; dredging during winter when juvenile fish are not present and dissolved oxygen levels are high will ensure that sulfide problems are minimal. Information available indicates that most heavy metals are tightly bound. Elutriate tests in Appendix B give an indication of short-term concentrations that may result.

R. Voiland

Comment: Paint chips, runoff from ships containing high levels of suspended solids and oil and grease, even though passed through a separator specifically made for the purpose, would add some pollutants as would dredging, especially metal contaminants.

Response: Impacts of paint chips and dredging have been addressed in the discussion on the Puget Sound Region. Decks of ships must be kept clean for safety reasons; therefore, runoff from the ships will not contain high levels of suspended solids, oil and grease.

H. Sanford

Comment: Dealing with oil spills in such an area is difficult and because of the many surrounding homes oil spills could be seriously damaging for the lake users and lake property.

Response: As a preventive measure against accidental oil spills, all NOAA vessels at Lake Union utilize an oil containment boom which surrounds the vessel hull at the waterline. Such practices would continue at Sand Point to ensure that any possible dockside fuel spill could be immediately cleaned up, and aquatic biota and adjacent shorelines would not be harmed.

K. Greggerson

Comment: How can the repainting of ships including sanding, scraping and sandblasting to remove old paint be done without paint lead flakes falling into the lake?

Response: Only light touch-up painting will be accomplished at the NOAA base, using a brush or roller. The paint used is not lead based and is nonpoisonous. Most paint chips and powder will be recovered and removed as solid waste. Any solid materials falling into the lake will be confined within the oil containment boom and removed.

J. McClelland

Comment: How many tugs and barges, dredges, and other support vessels will be involved in dredging and pier construction operations at Sand Point? Precautionary measures to prevent contamination of the water by these vessels should be spelled out in considerable detail.

Response: Vessel support requirements for dredging are determined by the dredging contractor who will perform the work. Contractor precautionary measures to prevent contamination of the water or spread of dredged materials will be included in the design and specifications. This will include the provision for the contractor to designate an environmental officer. The duties of this officer shall include the responsibility for enforcing the environmental provisions of the specifications, the requirements of the Occupational Safety and Health Act, and other applicable federal, state, and local standards including the precautionary measures in the Dept. of Army Section 10 permit for dredging in navigable waters.

K. Regan

Comment: The previous EIS is vague on the time for mud and silt to settle after dredging.

Response: According to National Marine Fisheries Scientists, most of the suspended solids in the water caused by dredging are expected to settle within 40 hours.

City of Kirkland

Comment: The contemplated berthing of NOAA vessels with facilities for servicing and fueling poses a serious threat of contamination to the waters of Lake Washington.

Response: Routine servicing of NOAA vessels includes repainting, washing, welding and equipment repairs and modifications. Organotin based paints which are far less toxic than lead based paints are used for repainting. Commercial cleansers used are food grade liquids which are highly water soluble, non-toxic and biodegradable (Ref. FEIS Pgs. 16, 17). The water quality impacts caused by the activities and long-term facility operations are expected to be minor (SEIS P. 2-48). Fueling of NOAA ships will not be performed at any of the alternative sites, including Sand Point.

R. Van Moppes

Comment: What are the solvents used to clean and maintain the exterior of the ships?

Response: Use of commercial cleaners are discussed in the Final EIS, on page 17. The commercial concentrates used by NOAA for vessel clean-up are food-grade liquids that are highly water soluble, non-toxic, and biodegradable. They are chosen because, among other characteristics, they have no affect on water fowl, aquatic animals, or plants, or humans, and their use is controlled by environmentally conscious professionals.

U.S. General Services Administration Region X

Comment: Page 2-6, Water Quality and Aquatic Biology; the statement concerning the use of a silt curtain and that daily monitoring would be done seemed to be undue restrictions for an agency to impose on itself.

Response: For sites where dredging is required and where water quality is shown to be a sensitive environmental element, it is NOAA's intention to conduct a water quality monitoring program to ensure water

quality conditions are compatible with survival of aquatic resources. Consideration will also be given to the use of a silt curtain to limit turbidity at these sites. These procedures are consistent with NOAA's missions for preservation of the marine environment and conservation of fishery resources and is not considered by NOAA as an undue restriction.

U.S. Department of Interior
Pacific Northwest Region

Comment: Stormwater runoff control measures should be more fully discussed. We recommend the installation and regular maintenance of oil and grease traps to protect water quality.

Response: Current plans for Sand Point include installation of an oil and grease trap system for the service portion of the NOAA site including vesel piers and staging area. In addition, each stormwater catch basin will be designed with an inverted outflow to contain any surface oil. Basins will be cleaned as part of a regular site maintenance program.

METRO, P. Peabody, Director,
Public Services Department

Comment: The final supplemental EIS should also address the issue of frequency of lock usage by NOAA ships. Lock usage can affect the flow of the Cedar/Green River which would impact on other uses of the river.

Response: The historic and projected frequency of NOAA's transit of the Chittenden Locks is identified on page A-16. NOAA's usage of the locks is insignificant when compared to the number of recreational transits. (For instance, in 1976 NOAA contributed less than 0.1% to the total number of lock transit.)

Comment: While we agree the potential for adverse impacts on water quality from NOAA operations will be minimal, we believe NOAA should develop a long-range monitoring program to document existing and ongoing water quality.

Response: Consideration of the need and provisions for a long-term monitoring program will be made after the final NOAA site is selected. A discussion of the proposed short-term monitoring problem for these sites where dredging is required is provided on page 2-6 of the draft SEIS.

Comment: Various monitoring programs are proposed as mitigating measures at each of the sites. However, it is often unclear which specific programs are recommended to adequately mitigate potential water quality impact and which programs will definitely be implemented. The description of the monitoring program should be revised to address these issues in the supplemental EIS.

Response: Table 4-2 identifies a number of mitigative measures to reduce potential adverse environmental impacts associated with NOAA's development. All mitigative measures will be reviewed and considered for implementation prior to making a final decision on site selection. The scope and procedures for a water quality monitoring program will be developed before water-related construction begins.

Comment: The discussion of dredge and fill operations at the Lake Union site does not clearly explain how these operations will be conducted. Will a rip rap wall be built away from the shoreline to contain the fill? Will only dredged spoils be used to create the fill area? If part of the shoreline area is to be filled, the final supplemental EIS should present an evaluation of potential water quality impacts from that fill.

Response: The continuation of the water quality and aquatic biology discussion of the Lake Union site was inadvertently omitted in the Draft SEIS. This has been corrected in the Final.

TERRESTRIAL BIOLOGY

State of Washington Department of Game:

Comment: It is likely that the "unmaintained species of grasses and weeds" present on the Everett site, would support a more diverse wildlife population than pigeons and gulls.

Response: Only small areas on the site are vegetated. Some small mammals and other bird species may also use the site.

Comment: If the facility is located at Kenmore, waterfowl feeding could be greatly reduced. This area contains a great amount of potamogeton. Some species of this plant serve as major items in the diets of coot, canvasback, goldeneye, mallard, pintail, redhead, ruddy duck, scaup, shoveller, teal, and goose. Also, secondary growth stimulated by the presence of a large facility could impact adjacent wetlands.

Response: The discussion has been modified to include these impacts.

Comment: With regard to the Manchester site, eelgrass beds are extremely valuable waterfowl areas and reduction of eelgrass beds would reduce waterfowl populations, especially black brandt.

Response: The discussion has been modified to include these impacts.

ARCHAEOLOGICAL AND HISTORICAL RESOURCES

U.S. Department of Interior, Pacific Northwest Region

Comment: The draft statement speaks of extensive modifications to most of the sites which would appear to preclude the presence of cultural resources. In order to satisfy the consultive requirement of 36CFR800, the final statement should contain a letter from the State Historical Preservation Officer which concurs with the agencies findings that no eligible cultural resources are present on those disturbed sites and that no survey is required.

Response: The response to a request for information on the status of the sites was as follows:

"As per your request, I have searched our site records and have found that an archaeological site, 45KP19, has been recorded at the location listed in your request as the Manchester site, Kitsap County, T24N, R2E, Section 9. Unfortunately, your map does not indicate topography or section boundaries. Without these specific data, I cannot evaluate the potential for impact to the archaeological resource.

In addition to the archaeological site, the Manchester location includes a portion of the Fort Ward Historic District, a property listed in the National Register of Historic Places.

Although none of the other alternative site locations listed in your request have known archaeological properties, all of them have more or less potential for the occurrence of previously unknown resources because of their situation on major bodies of water." Sheila A. Stump, Historic Preservation Specialist.

No additional comment on the draft SEIS was received from the State Historical Preservation Office.

NOISE

R. Leed

Comment: What preventive measures does NOAA plan to control the noise level of loading ships and running engines for 24 hours before departure from the piers?

Response: Engines will be run only two to six hours prior to departure. The FEIS (p. 47) indicates that the maximum noise levels at the nearest residential boundary due to dockside equipment noise is 52 dBA. This level is below the state noise standard and within ambient noise levels shown in Table 11 (p. 27). The noise levels shown in Table 23 (p. 46) are at a higher RPM than normal warmup prior to departure from the pier. A noise survey by Vibracoustics (1974) on the RAINIER found that the noise level at 90 RPM was 54 dBA and the noise level at 190 RPM was 57 dBA. With distance attenuation of noise, this noise level will be below the ambient noise levels shown in Table 11. PMC has received no complaints about this source of noise.

J. Forde, F. Forde

Comment: The supplemental EIS does not discuss how effective the noise controls will be.

Response: The mitigation measures for construction equipment may reduce the noise levels from 2 to 10 dBA depending on the equipment in use. If the Sand Point site is chosen, NOAA plans to dock the noisiest ships (Class I) at the dock farthest from residential areas. Except in emergency situations, docking of NOAA ships will only take place in the daytime.

W. Steward, C. Hilgeford

Comment: What about noise levels originating from the NOAA ships?

Response: Concern about ship noise has been raised by some who have read a study by Harris F. Freeman & Associates (1972). This report stated that noise levels produced by the "OCEANOGRAPHER would be more than unacceptable during daytime periods and even more serious at night." This report, however, does not consider that all Class I vessels (the noisiest in the NOAA fleet) will be docked at the berth farthest from shore. This berth area is farther than the close approach considered in the Freeman study. A more recent study, Vibracoustics (1974), stated:

"In evaluating the total effect of the vessel noise and related dockside operations, one may conclude that the Class I vessel OCEANOGRAPHER is the only existing NOAA vessel whose underway noise could have an adverse effect on the Sand Point residential community. This predicted noise is considered insignificant to minimal since the OCEANOGRAPHER only makes an estimated 2 to 4 trips per year, including its annual drydocking. In addition, its noise levels would probably not be detected on the west side of Sand Point Way N.E. due to the background traffic noise."

The FEIS indicates that the dockside equipment noise is 52 dBA (p. 47) at the nearest residential area. This is below state noise standards. On September 27, 1978 noise measurements using a survey meter were taken at the NOAA dock at Lake Union while three ships were docked. Noise levels ranging from 59 to 67 dBA at 25 feet from the ships were recorded. Some minor maintenance was also in progress when these measurements were made. These noise levels would be barely audible at the nearest residential area. Major ship repair will be undertaken at commercial shipyards.

C. Hilgeford

Comment: What is the total noise factor when added to the current ambient noise at the Sand Point site?

Response: The determination of the total noise factor of the Sand Point site is difficult to determine because the activities vary from day to day and month to month. Nonetheless, an example may clarify the issues. If we assume a peak traffic noise (0.5 dBA increase on p. 47) and the noisiest NOAA ship docking (OCEANOGRAPHER at the nearest residences generates a noise level of 59 dBA), the noise increase over an ambient noise level of 58 dBA would be a total maximum increase of 4.5 dBA during two rarely occurring simultaneous conditions. A noise level increase of 3 dBA is barely perceivable. The estimated total average noise increase adjacent to the site would be in the range of 1 to 3 dBA.

C. Messer

Comment: The 10-second whistles required to alert the bridge tenders and for takeoff and arrival at Sand Point would be a real noise factor.

Response: The 10-second blast is required only when ships are backing away from the berth. This would occur only a maximum of 60 times per year, for a total of 10 minutes each year. A typical bridge opening requires a signal consisting of a long blast (4-5 seconds) followed by 1 to 3 short blasts (1-2 seconds each). With a maximum of 120 ship transits each year, such short durations are not considered to be a significant noise factor.

F. Badgely

Comment: A question to which I don't have the answer but which could be determined with a little on-site research is whether house-boat dwellers on Lake Union have had any complaints about NOAA-caused noise.

Response: In the past two years the Director's office at the Pacific Marine Center has received only one phone call complaining

about the noise, which was caused by a ship's public address system. No other noise complaints have received in recent years.

L. Cox

Comment: The City of Seattle does not have an adequate noise limit code so that NOAA ships could make intolerable noise at all hours of the day or night without prosecution.

Response: The State of Washington and the Federal government do have noise standards that are adequate to protect public health. If a project exceeds these standards, corrective or mitigative measures must be undertaken by the responsible party.

E. Kuhrau

Comment: The discussion under the heading "Existing Conditions" does not adequately establish baseline data with respect to the existing ambient noise levels.

Response: The SEIS drew upon two studies, Vibracoustics (1974) and Harris F. Freeman & Associates (1972), which are summarized in Table 11 of the FEIS. To include all of the background data available would make this and all other sections of the EIS's cumbersome. These reports are referenced so that interested parties can examine them in more detail. On September 26, 1978 at 2:00 p.m. and 3:30 p.m., noise measurements were conducted at Fairway Estates and Sand Point Way & 79th Street for one hour each to determine the present validity of Table 11 in the FEIS. The ambient noise level at Fairway Estates was found to be 49 dBA, and the noise level at Sand Point Way & 79th Street was found to be 56 dBA. Both of these values are within the ambient noise levels given in Table 11.

Comment: There is nothing in the final EIS or the supplemental EIS which addresses the noise and impacts of the activities described in Appendix H of the supplemental EIS or of mooring ships in a residential neighborhood.

Response: Although some of the activities described in Appendix H might be audible away from the site boundaries, to assess these impacts quantitatively is not possible because these activities vary from year-to-year, month-to-month, and day-to-day and because the noise levels are dependent on the individual activity being performed. To obtain a qualitative idea of what the noise measurements are like, on September 27, 1978 noise measurements were made at the NOAA dock at Lake Union. Noise measurements ranging from 59 to 67 dBA at 25 feet during a low routine maintenance period were recorded. These levels would indicate that the noise levels would at best be barely audible by the nearest residents at Sand Point.

These measured noise levels would support the FEIS estimate of 52 dBA at the nearest residential boundary due to dockside equipment noise (p. 47). Major vessel repair activities will be undertaken at a commercial shipyard outside Lake Washington.

J. McClelland

Comment: Noise study does not address the fact that other comprehensive noise studies were conducted

indicating that the noise of NOAA ships during docking exceeded noise standards.

Response: The FEIS noise assessment was based on the Harris F. Freeman & Associates report (1972) and the Vibracoustics report (1974). Other noise studies on NOAA ships are unknown to URS or NOAA. Therefore, response to this comment cannot be undertaken until these other studies are referenced or provided by Mrs. McClelland.

R. Bruce

Comment: Activation of this proposal for consolidation or collocation of NOAA facilities will of necessity generate excessive noise for several months of construction. Thereafter, there will be considerable noise indefinitely for normal operations, repairs, servicing and trucking supplies for ships berthed at the proposed piers.

Response: As indicated in the SEIS, the project does have a potential of creating a short-term noise impact during construction at several proposed sites. Long-term noise impacts at all sites except South Mukilteo would not be significant. Normal operational noise will not be substantial, as discussed in response to a comment by Mr. Kuhrau.

ECONOMIC FORCES

H. Dorman

Comment: The business people in University Village, Sand Point, Laurelhurst and the 25th Street areas would conceivably lose patronage as a result of traffic congestion due to government vessel transits through the Portage Cut.

Response: There is no reason to expect that the increase in the numbers of bridge openings by passage of NOAA vessels would adversely affect local businesses.

D. Harsch

Comment: What would be the cost of building adequate quarters for the ship-related facilities at a combined site on a Lake Union/Salmon Bay concept?

Response: Both the Lake Union-PMC and Salmon Bay sites considered in the Supplemental EIS have sufficient land area to accommodate NOAA waterfront operations, therefore, a combined site would not be necessary. Building at Lake Union would require acquisition of land with an estimated market value of $3.1M (according to GSA) and construction of additional office and storage spaces. To meet a 40-year life standard (for new construction), the present piers would have to be demolished and replaced with new concrete piers and piles. Dredging and fill would also be required. Federal acquisition of the Salmon Bay site would probably require condemnation resulting in considerable expense, displacement of businesses, and relocation reimbursements. (Availability was questionable; see Table 1-4. Further investigation indicated condemnation would probably be needed.) Demolition of existing structures and some dredging would be needed before constructing new piers and buildings to meet NOAA's requirements. It is estimated that the Salmon Bay site would be more costly to develop than Lake Union-PMC. (For further information, see "Operation Considerations for Site

Selection of a Western Regional Center").

R. Bruce
R. Phelps

Comment: I believe that the cost comparison of a split site location versus the proposed Sand Point location for the NOAA facilities should be discussed in detail in the draft SEIS, including the additional cost of construction of new docking facilities versus the cost of remodeling or renovating the existing docks.

Response: As indicated in responses to similar comments, developing accurate cost estimates for various alternative locations requires considerable time and expense if the information is to be meaningful. Congressional action appropriated funds for engineering and architectural design specifically for facilities planned for Sand Point. Such a large commitment of resources to develop designs for facilities at other locations could be viewed as a missappropriation of these funds. However, to assure that economic factors are included in the final decision, comparative site alternative development information was included in the report "Operational Considerations for a Western Regional Center" as referenced in the SEIS.

J. Sweek
C. Noonan

Comment: What is the cost comparison of development between the various alternative sites?

Response: It is impossible to calculate realistic site development costs for each of the ten alternative locations without an extraordinary commitment of both time and resources. Each site would require complete pre-concept designs and construction cost estimates by a competent Architect-Engineer firm. Soil borings to determine foundation requirements, hydrographic surveys for dredging and pier design, and determination of available utilities are examples of the work which would need to be accomplished before site designs and building could begin. Other cost factors include land acquisition and possible business relocation reimbursements. Time estimates and their attendant delay costs would need to include land negotiations (with possible condemnation), land use permits, and Congressional permission for securing additional federal lands. Committing for this purpose significant resources which were appropriated for developing Sand Point would entail budgetary reprogramming and require Congressional approval.

Due to these restrictions and the belief that such an effort would outbalance consideration of other factors including the environment, NOAA established a multi-disciplinary committee consisting of representatives of NOAA, GSA, and Naramore Bain Brady and Johanson to qualitatively compare development requirements for the site alternatives. Information on property acquisition, site suitability, and other cost considerations were also developed. This information is included in the referenced report, "Operational Considerations for Site Selection of a Western Regional Center." For site development, the report ranks the seven alternative sites as follows with the site requiring the least development first:

1. North Hylebos
2. South Hylebos
3. Kenmore

4. Sand Point
5. Everett
6. Manchester
7. South Mukilteo

For further information, see responses to R. Bruce and B. Yarneau.

R. Phelps

Comment: The current annual rent including maintenance for piers, warehouse, shop and offices is $176,800 annually. Admittedly, this cost would increase but would still not come close to the cost of construction at Sand Point which will be $16.651M excluding the location and inflation costs.

Response: The current annual lease cost for the Pacific Marine Center is $176,400 for an office space of 33,677 sq. ft. and 1,080 linear feet of piers. If the lease were renewed in June, 1983 (current lease expiration date) with no upgrading of present facilities, the cost estimated by GSA would be approximately $400,000 per annum. Space needs by PMC as documented in the NOAA Program of Facility Requirements indicate a total requirement for 66,800 sq. ft. of office space and 1,690 linear feet of piers. This expansion is not possible at the present Lake Union site, but if it were, the anticipated lease costs for a 20-year term would be over $1M per year.

LAND USE

Edward W. Kuhrau

Comment: Vessel maintenance activities described in Appendix H constitute adverse impacts to the social environment and land use near the Sand Point site. Those activities are inconsistent with state and local land use planning policies which seek to avoid juxtaposition of industrial type activities and residential areas.

Response: The inconsistency between the proposal and present zoning classification at Sand Point is noted on p 2-49 of the draft SEIS and considered an adverse impact.

R. Bruce

Comment: There is no indication in the impact statement how the visual, noise, air, industrial lighting at nighttime and reoccurring announcements on the public address system will be reconciled with residential and recreational amenities in the neighborhood.

Response: Air quality and noise impacts are addressed in Chapter 2 of the SEIS. Nighttime lighting and landscaping plans are covered in the original FEIS. There are no plans for an outside public address system at Sand Point; although ship's public address systems are occasionally used for communication between ships, in the past two years only one complaint about this noise has been received from the houseboat community located near the present moorage facility at Lake Union.

P. Parker

Comment: It is absolutely essential that regional population changes and regional planning efforts be given at least equal consideration as analysis to other concerns in the EIS. This is not only a question of pollution, safety and aesthetics,

but equally, a question of the best use of a rapidly diminishing and highly demanded resource, waterfront property for a growing population. This issue of regional planning is not properly addressed in the EIS, nor at all in the supplement that has come out.

Response: NOAA plans to collocate at Sand Point would not significantly affect regional population trends. Planning for use of waterfront properly must be part of Shoreline Management Programs. Compatibility of the NOAA facility with applicable plans is discussed in Chapter 2 of the SEIS.

State Department of Ecology

Comment: The Department of Ecology supports the location and development on Lake Washington of the basic onshore facilities for research, public education, and administrative purposes. Such activities are consistent with the state's emerging role as a leader in oceanographic research and development. Its impact on local and state economy will be significant. Collocation of the vessels at the site, however, seriously reduces the desirability of the entire proposal. DOE has concluded that while NOAA might not be strictly subject to the programs resulting from the Shorelines Management Act and the Federal Coastal Zone Management Act, NOAA would nonetheless conduct their activities in a manner consistent with those programs to the maximum extent possible.

Response: Acknowledged.

M. Cowan

Comment: Having big ships going in and out certainly hampers the use of Matthews Beach and Magnuson Park as recreational areas for swimmers and water skiing.

Response: Transiting NOAA vessels would not impact the recreational uses of Matthews and Magnuson Park beaches. NOAA ships would come no closer than 0.5 miles from Matthews Beach when docking and would be considerably further away from Magnuson Park Beach when transiting Lake Washington.

S. Gorton, Attorney General
State of Washington

Comment: The docking of large and small NOAA vessels will limit the opportunity of recreational users, including boaters, sports fishermen, water skiers, skin divers and swimmers.

Response: Designating only a fraction of one percent of the Lake Washington area for the berthing of NOAA vessels is not considered as inhibiting or limiting to any measurable degree the lake's recreational use.

Comment: The NOAA proposal to berth ocean-going ships at Lake Washington is not only inconsistent with the strong policies of the Shoreline Management Act requiring that uses should be compatible with the surroundings and protection of public recreational rights but also with the stringent policies of use preference on shorelines of statewide significance. Of special note, your

attention is directed to the only precise expression of State policy dealing with large ships in Lake Washington developed by the SMA, namely the policy developed in the document entitled "Lake Washington Regional Shoreline Goals and Policies" which provides that: "moorage, storage, servicing and operation of facilities for ocean-going or commercial ships and barges should not be expanded on the shorelines of Lake Washington." This, the most precise statement of policy developed under the State's Shoreline Management Act, is quite clear. No long ships in Lake Washington.

Response: NOAA does not believe the proposal to berth research vessels at Sand Point is unacceptably incompatible with the surroundings or that the public's recreational rights are jeopardized in any way. The property that NOAA proposes to develop is former military installation/air strip, characterized in large part by aircraft hangers, barracks-like buildings and thousands of square feet of asphalt runways. To the extent NOAA's proposal contemplates low-rise, carefully designed buildings in a campus-like setting, and extensive landscaping, it would indeed differ from the present surroundings. Whether this contrast would be unacceptable is a matter of personal taste.

NOAA's proposals would enhance the public's recreational rights by making available for public use on a limited basis, portions of the Lake Washington shoreline now closed for that purpose.

NOAA acknowledges the inconsistency between the proposed action and a report entitled "Lake Washington Regional Shoreline Goals and Policies." (See Land Use Section for Sand Point). However, to consider the report the only precise expression of state policy is to ignore the special emphasis placed on local shoreline management programs by The Shorelines Management Act of 1971, RCW 90.58, et seq. The shorelines of Lake Washington are presently subject to a variety of uses. The task of determining priorities among uses and reconciling differences of opinion regarding the use of a particular shoreline was delegated by the SMA to the local government having jurisdiction over that area -- in this case, the City of Seattle. As indicated in Appendix G, NOAA's proposal is consistent with uses designated as appropriate for Sand Point by the Seattle Shoreline Master Program.

R. Bruce
G. Van Winkle
R. Leed
Beaux Arts Village
R. Phelps
City of Mercer Island
R. Sandiss
M. Hamilton
H. Stevenson

Comment: NOAA's development in Lake Washington will violate the Lake Washington Regional Shoreline Goals and Policies.

Response: NOAA has acknowledged the inconsistency of the proposal with a report entitled "The Lake Washington Regional Shoreline Goals and Policies", written by a local advisory group. This inconsistency is fully described and discussed under the land use section of Sand Point. NOAA does not believe its proposed activity at Sand Point is contrary to any applicable state legislation. The activity would be consistent with the Seattle Shoreline Management Program.

City of Kirkland

Comment: The proposed dredging within Lake Washington and the proposed berthing of vessels are both inconsistent with the Lake Washington Regional Goals and Policies and the shoreline master programs of those jurisdictions on Lake Washington whose master programs were developed in conformance with the Regional Goals and Policies for Lake Washington.

Response: The inconsistency of the proposed project with the Goals and Policies of the Lake Washington Regional Citizens' Advisory Committee is thoroughly discussed under the Land Use section for Sand Point.

Bellevue Coalition of Community Clubs

Comment: NOAA's plans for Sand Point violate the Goals and Policies of Lake Washington and Bellevue's "Shoreline Management Program Policy Element."

Response: NOAA's proposed activity at Sand Point is neither consistent with nor in any way subject to the statement contained in either of these documents. As stated before, the Seattle Shoreline Master Program is the controlling policy statement and regulatory framework governing the development proposed in this document at Sand Point.

L. Wilkins

Comment: It is apparent from the evidence presented in the court and now from the Supplemental EIS that NOAA irrevocably committed itself to a co-location of its regional headquarters and the berthing of its ocean-going vessels at Sand Point, thus thwarting the intent of Congress and the enactment of NEPA.

Response: It was clearly stated in the Draft Supplemental Environmental Impact Statement and is reiterated in this document, that no final decision regarding NOAA's proposal to consolidate its activities at a Western Regional Center at Sand Point would be made by NOAA's Administrator until all environmental data was assessed and other relevant factors, including public comments, were considered. (See Introduction to the supplemental statement.) This procedure is not contrary to either the National Environmental Policy Act or the intent of Congress.

N. Licata
D. Haas
H. Sanford
A. Warsinske
C. Gustafson
A. Gustafson

Comment: Such an installation (at Sand Point) would violate the principles and the spirit of the Shoreline Management Act of the State of Washington.

Response: The Shoreline Management Act of 1971, RCW 90.58 et seq., contains no regulatory measures or other proscription which deal with any of the activities which NOAA proposes at Sand Point.

D. Harsch

Comment: NOAA's plans for Sand Point are clearly incompatible with the Conservancy Management (CM) classification of the Seattle Shoreline Master Program.

Response: The City of Seattle Department of Community Development is responsible for promulgation and implementation of the Seattle Shoreline Master Program. That department reviewed NOAA's original Final Environmental Impact Statement and concluded that the development proposed in that document and its operations would be consistent with the Seattle Shoreline Master Program when conducted and mitigated as described in the FEIS. This conclusion was based on an analysis of the compatibility of NOAA's plans with the Conservancy Management classification of the Seattle Shoreline Master Program. For similar information, see page 2-44 of this Impact Statement.

City of Bellevue
W. Parness, City Manager

Comment: The Bellevue City Council expresses concern that the proposed National Oceanic & Atmospheric Administration ship facilities at Sand Point violates the Shoreline Management Goals for Lake Washington drafted and duly appointed by the Shoreline Management Citizens' Advisory Committee and accepted by the State Department of Ecology.

Response: Acknowledged.

H. Dorman

Comment: NOAA and the attending activity would detract considerably from the enjoyment of Magnuson Park.

Response: Similar concern was expressed during hearings on the FEIS (see FEIS, pp. 66-68). Part III of the FEIS (pp. 18-19) discusses coordination with the Seattle Department of Parks and Recreation and other appropriate city departments to ensure visual consistency and functional compatability between the two developments.

B. Smith, Jr.
R. King
P. King

Comment: This area should be maintained as a residential and recreational area in accordance with the state statute approved by the State Department of Ecology. NOAA's plans for building and maintaining this facility are completely incompatible with the above goal.

Response: The Shoreline Management Act of 1971, RCW 90.58, et seq. contains no regulatory measures which deal with any of the activities NOAA proposes at Sand Point. The overall character of Lake Washington can be segregated into individual qualities or uses. These include recreational and residential (recent growth of private boating and new public parks with day moorages), business and commercial (private marinas, sea plane ports, and offices), industrial and manufacturing (log rafting, sand gravel barging, hydrofoil manufacturing), and government (Naval Support Activity). Considering the varietal uses, NOAA believes its proposal for Sand Point is compatible with the aggregate character of Lake Washington.

T. Mullendorff
M. Hamilton
A. Warinske

Comment: Lake Washington Regional Goals and Policies must be observed in accordance with state statutes.

The Shoreline Management Act supports maintaining the residential/recreational character of Lake Washington and protects the lake and shorelines from further commercial, residential developments.

Response: NOAA is in compliance with all state statutes applicable to federal agencies. The activities proposed by NOAA at Sand Point are not considered as commercial uses and are compatible with the aggregate use of Lake Washington. Movement of NOAA vessels in the lake is not establishing a precedent for ocean-going use since the lake is currently being used by both commercial and recreational ocean-going vessels.

UTILITIES AND ENERGY

H. Sanford

Comment: The additional burden added to the present sewer system could very well cause some strain on present installations.

Response: The existing sanitary interceptor is capable of handling the additional sanitary flow estimated for the proposed NOAA center at Sand Point. (See page 2-50.)

TRANSPORTATION AND CIRCULATION

R. Bruce

Comment: Required bridge openings will be prolonged since NOAA ships are about 10 times longer than the average recreational craft. In addition, because traffic over the Montlake and University Bridges to the University of Washington is heavy, it is important to provide estimates of current and future traffic loads as well as congestion imposed by bridge openings for NOAA vessels.

Response: The latest traffic information available was used in the formulation of traffic and circulation impacts. Future growth is determined by many variables, and is at best an educated guess. NOAA has said that openings for their vessels would be during non-peak automobile traffic time. Congestion would be completely dependent on the traffic volume present at the time of the bridge opening. It should be noted that only three NOAA ships are approximately 300 feet long.

Comment: Construction of the North Gate for access to NOAA from Sand Point Way N.E. creates new traffic hazards. The gate is diagonally opposite the only access road to Fairway Estates which is used by over 150 residents. There is no provision for left-turn lanes or traffic lights to control the flow of traffic.

Response: NOAA's plans for development at Sand Point include redesign of the intersection including provisions for traffic channelization and a traffic signal.

Comment: This section of Sand Point Way N.E. also converges from a 4 lane major arterial with posted speed limits of 40 mph south of the new gate to a 2 lane arterial immediately adjacent to Pontiac Bay north of the new NOAA gate with a posted speed limit of 30 mph. Indeed it seems extraordinary that the very detailed SEIS just published does not identify any of these details.

Response: The roadways (lanes) available are adequate for existing and projected traffic, including that generated by NOAA.

J. McClelland

Comment: With respect to traffic, the inconvenience to residents of Inverness, Fairway Estates and apartments along Sand Point Way near the North Gate will be considerable.

Response: The operation of NOAA at the Sand Point location is not expected to cause any major "inconvenience" to other users of the area's arterial system. Most of the NOAA generated peak traffic is expected to be moving in the direction opposite to the existing peak hour traffic flow and will tend to help in balancing the traffic flow.

L. Wilkins

Comment: There are no up-to-date surveys relating to water traffic through the Montlake cut nor vehicular traffic over the Montlake bridge upon which estimates of future traffic and bridge openings can be adequately based.

Response: Traffic information used in the preparation of the SEIS was the latest available from the appropriate agencies.

Comment: Increases in the number of Sand Point area apartments, in use of Magnuson Park, and in NOAA personnel living and working in the area should be considered when estimating the number of bridge openings.

Response: These factors are not expected to have any impact on bridge openings.

N. Licata

Comment: A Montlake bridge accident similar to the West Seattle bridge collison would cause serious inconvenience to vehicular and foot traffic.

Reponse: Any interruption of a traffic corridor causes inconvenience to traffic, whether it be caused by a vehicle accident blocking a road for an hour or so or a major problem such as the West Seattle bridge. Likelihood of such an accident is discussed in the responses to comments dealing with Navigational Risk.

City of Tacoma,
M. Parker, Mayor

Comment: The assessment of transportation and circulation relative to the north Hylebos site is unclear. The narrative assessment states that "impact on traffic and circulation would be minor for all sites except Manchester," a statement which we do not question. However, the ratings on pages 3-10 and 3-12 show progressively higher adverse impacts at the Hylebos site, conclusions with which we disagree. This is an inconsistency which downgrades the Hylebos site and which deserves clarification.

Response: The transportation and circulation ratings in Table 3-1 refer to the overall impact expected at the various sites and on the connecting roadway systems. Ratings of both Hylebos sites were affected by existing congestion at the I-5 interchanges and by the general street and shoulder condition in the immediate site location.

The rankings in Table 3-3 indicate relative desireability of the

various sites in order of specific suitability of the existing street/road system. The difference between the North and South Hylebos sites is primarily caused by the questionable reliability of the drawspan on E 11th Street and the traffic restrictions imposed by the physical dimensions of the structure.

NAVIGATIONAL RISK

J. McClelland
T. Winter
R. Hass
M. Hamilton
H. Sanford

Comment: Use of Lake Washington by NOAA vessels will conflict with recreational uses of the lake and the ship canal. Specifically: 1) Swimmers and boaters in the LWSC are very difficult to see from larger ships and may be placed in jeopardy with passage of large NOAA ships; 2) Small craft and water skiers have every right to claim priority use of Lake Washington; and 3) What will the effect on scheduled boat races of NOAA's location in Lake Washington be?

Response: 1) NOAA recognizes this concern as a potential problem when recreational usage is heavy in the Montlake Cut and in Union Bay. Hence, NOAA, if a Lake Washington site is selected, will consider using an "advance" boat, when warranted, to warn recreational users of the waters prior to the passage of large NOAA vessels. 2) The waters of Lake Washington are within the public domain and, as such, open to all users. In the broad and deep waters of Lake Washington, reasonable attention to normal safety practices will prevent any conflict between the users (both public and private) of these waters. 3) The waters of the LWSC and/or Lake Washington are presently "reserved" for certain scheduled races. NOAA vessels, alerted to these well known events, would avoid transits at these times.

R. Bruce
B. Yarneau
N. Licata
M. Hamilton
R. Leed
W. McCurdy
C. Messer
M. Cowan

Comment: What assurances can NOAA give that one of its ships will not disable a bridge (specifically the Montlake Bridge) causing much property damage and great inconvenience to the public?

Response: No such assurance can be given. As stated in the draft SEIS (page A-73), accidents are probabilistic in nature and occur as random events, usually as a result of the juxtaposition of several unforeseen or unforeseeable circumstances. However, by identifying and evaluating those risks which are foreseeable, appropriate action can be taken by NOAA to mitigate the perceived risk and to minimize or prevent future occurrence. In this particular case, i.e., a NOAA vessel ramming a bridge, NOAA has already adopted the policy of sending an advance person to each bridge prior to the anticipated transit of a NOAA vessel to alert the bridge tender and to minimize possible misunderstandings between the ship and the bridge tender. Additionally, in the near future, all city-tended bridges on the LWSC will have the capability to talk (via radio) with all approach-

ing vessels. Once the Montlake bridge is fully open, a ship would ground on the walls of the Cut before it would come in contact with abutments, precluding any possible damage to the bridge itself.

Historically, as noted in the SEIS, none of the bridges on the LWSC have been damaged severely enough in the past to force closure. Further, the Montlake Bridge has the lowest accident incidence of any of the bridges on the LWSC. This record, when contrasted to accidents in other waterways, such as the extended closure in mid 1978 of the Spokane Street Bridge due to a ramming, can be accounted for in several ways: (1) currents and tides are minimal in the LWSC (for example, in other waterways, some bridge rammings have been caused by currents sweeping the ship into the bridge or its abutments); (2) ships using the LWSC are generally much smaller than those in areas where such rammings have occurred; (3) impact of a ship with a bridge at the slower speeds typical of the LWSC (seven knots is the legal limit -- NOAA vessels proceed at about four knots) would cause less damage than at higher impact speeds; (4) bridge abutments in most cases are well protected from possible ramming by ships.

H. Stevenson

Comment: Wind in Portage Bay was not discussed.

Response: The statement in the draft SEIS on page A-9 to the effect that "the hills surrounding the LWSC moderate the winds therein" pertains to Portage Bay. No concerns were identified as to wind-related problems in transiting Portage Bay or in aligning vessels for eastbound movements into the Portage Cut.

D. Irvine
G. Olsborg

Comment: The apparent NOAA accident rate (1.3 accidents per 1,000 port calls) appears to be incorrect.

Response: Because of the relatively few port calls (about 750 over 19 years) and the low number of reportable accidents (1 in the same period), a statistically valid accident rate cannot be detemined. However, there is no evidence to indicate that this "apparent" accident rate is either a "fluke" or a short-term phenomenon.

G. Olsborg
R. Barto

Comment: Vessels much larger than those of NOAA have transited the Portage Cut in the past; cannot NOAA vessels transit the Portage Cut safely at present? Or will hull clearance present a problem?

Response: Ocean-going vessels, much larger than the largest NOAA vessels, have transited the Portage Cut in past years. Large NOAA vessels have also made this transit (for example see the transit of the OCEANOGRAPHER from Lake Union to Lake Washington by Capt. Barbee, 1975). However, these past transits do not provide a completely satisfactory comparison because: (1) the recreational usage of the Portage Cut and adjacent waters has increased in recent years, compounding navigational problems; (2) records on operational problems (such as scraping the walls of the Portage

Cut) have not been maintained and are not available for use in identification of potential risks. In any case, NOAA must rely primarily on present perceptions, rather than on historical data. The depth of the channel through the Portage Cut provides adequate hull clearance for NOAA vessels in the Portage Cut is not seen as a serious concern.

P. Bement

Comment: Two 50-gallon oil spills by NOAA in Lake Union were not reported.

Response: Data on oil spills by NOAA in the LWSC was obtained from two sources: the Pacific Marine Center and the U.S. Coast Guard (see memo: Zabrinski, C. G. to Spearman, C.O.E. - Recent NOAA Spills, 7-27-77). These two sources were in agreement. There is no reason to believe that additional spills have occurred.

Port of Tacoma
Mayor City of Tacoma
A. Duxbury
M. McDermott
M. Newman

Comment: The conclusions related to accident rates are not sound because of variety of data bases (real, extrapolated, average, and hypothetical) were compared: a scientifically unacceptable approach.

Response: Valid statistics for rare events, such as ship accidents, can best be obtained by aggregating small data bases either over time or for a large geographical area, however the resolution of the data suffers from such aggregation. In some instances, even these practices do not suffice and other, sometimes indirect approaches must be employed. In attempting to identify differences between sites, which in some cases are not active ports, a variety of data bases had to be used. Concern with respect to the validity of comparing these data bases will be discussed below.

1. Directly applicable historical data basis: study of the Ports of Everett (1974-1977), Tacoma (1971-1977), and, for comparative purposes only, the Port of Seattle (1974-1977) was based on the 13th District Coast Guard files. (As a result of comments received at the public hearings, the Coast Guard accident files were again reviewed by URS. More detailed information on accidents was obtained in this review and is reported in the Final SEIS in Tables 6 and 7. Minor errors, which did not change any of the results, were also found in this review, and were corrected.)

2. Indirectly applicable historical data bases: study of nine representative small port systems (1971-1975) based on U.S. Coast Guard, Washington, D. C. files as collated by the Oceanographic Institute of Washington. The resultant mathematical model which describes accident rates for small ports (<1,500 freighter port calls per year), was applied to the candidate sites at Mukilteo and Manchester.

These first two data bases examined freighter (>18 ft. draft) accidents only, assuming, in lieu of other data, that freighters, because they share a number of characteristics with NOAA vessels, would have similar accident rates.

3. Historical data with indirect application: the 13th District

Coast Guard files provided information on all commercial vessel accidents within the LWSC. Accident rates were then developed (from Corps of Engineers data) and prorated, using the OIW mathematical model for small ports, to arrive at an extrapolated accident rate for freighters for the LWSC.

A separate "hypothetical" analysis (Section V) was conducted to identify and provide detailed information on navigational risks in the LWSC and the relative impact of such identified risks on transits through the LWSC. This "hypothetical" analysis was not compared with historically derived data. Clarification on this matter has been introduced into the SEIS (Section VI).

Port of Tacoma and City of Tacoma (M. Parker, Mayor)

Comment: The historical data base (from Coast Guard files) is sparse or inadequate:

1. The observation period for accidents in the Port of Tacoma is not sufficiently long.

2. Only "real" data was used for the Port of Tacoma.

3. The data for Tacoma Harbor does not pinpoint accident locations.

4. Accident data for the entire Port of Tacoma was applied to the Hylebos Waterway; this latter site should have a separate accident rate developed for it.

Response:

1. The observation period for the Port of Tacoma has been increased from 1971-1976 to 1971-1977 -- an adequate base covering about 3,500 freighter port calls. Additionally, Coast Guard accident reports have been rechecked for the period 1974-1977 for the Port of Tacoma; minor errors were corrected and each accident was categorized as to type and magnitude.

2. As discussed in the previous comment, "real", i.e., historical data, was used for all cases.

3. A map has been added (Figure 8) indicating the locations of each accident in the Port of Tacoma in the period 1974-1977. These accidents are also listed in Table 6. Additionally, a map showing the route which NOAA vessels would take in reaching the Hylebos Waterway has been included (Figure 12).

4. A separate accident rate would have been developed for the Hylebos Waterway if a sufficient data base had been available. However, only accident location could be delineated by waterway; port calls could not. (Even if the number of port calls to the Hylebos Waterway could have been determined, the number of such calls in an 8-year period would have been small, clouding the statistical reliability of the result.) In lieu of more detailed information, the accident rate of the Port of Tacoma is used. Figure 8 (added to the Final SEIS) shows that the Blair Waterway had many more accidents in the period 1974-1977 than did the Hylebos Waterway (8 and 2, respectively). The development of good statistics on the usage of the various waterways in the Port of Tacoma could be a useful tool in clarifying accident rates within each waterway.

By way of contrast, it is possible to differentiate the accident rate for the Port of Seattle (of which the LWSC is a part) because the Corps of Engineers provides a breakdown on port calls to the two portions of the Port of Seattle,(i.e., the LWSC and Elliott Bay which are geographically and navigationally separate entities).

Port of Tacoma

Comment: Port calls for private piers are not listed in computing accident rates for the Port of Tacoma.

Response: Confusion between the Port of Tacoma -- a generic term used by the Corps of Engineers to identify all commercial shipping activity within Commencement Bay and waterways therein and the "Port of Tacoma" -- a publicly owned corporation, is believed to be the basis of this comment. An appropriate clarification has been introduced into the SEIS. The Port of Tacoma is used in the study in the generic sense and does include all port calls to both public and private piers.

M. McDermott and A. Duxbury

Comment: Fires have been included in the accident data for the LWSC; they should be excluded since they are independent of the characteristics of the channel.

Response: The point is well taken even though fires are included in accident rate determination (cf., OIW). The accident rate for the LWSC and Lake Washington was recalculated without fire-related accidents. The resultant accident rate (for freighters of 218 foot draft numbered in collisions, rammings or groundings) was virtually unchanged in this analysis. A footnote to this effect has been added.

A. Duxbury

Comment: The Coast Guard indicated (after a brief search) that they had no record of a bridge ramming in Lake Washington in the period 1974-1977.

Response: The accident referred to in Appendix A, as identified in the Coast Guard accident file, involved a barge hitting a bridge (unspecified) in Lake Washington in October, 1974. Damage was minor.

M. McDermott

Comment: The term "standard deviation" has been misused.

Response: This error has been corrected.

B. Smith, Jr.

Comment: I consider NOAA as commercial-type ships.

Response: The design characteristics and cababilities of NOAA vessels are not typical of commercial-type ships. See Appendix 4 to the navigational risk assessment.

Montlake Community Club

Comment: Why should Portage Cut be dredged to accommodate NOAA vessels?

Response: The current dredged depth of the Lake Washington Ship Canal is adequate to acommodate NOAA vessels. As discussed on Page A-40, removal of a shoal near the edge of the dredged channel would improve vessel maneuvering room and provide a waiting area for vessel traffic; however, it is not necessarily required for safe transit. This is one of the proposed mitigating measures shown on Page A-53.

K. Regan

Comment: NOAA's EIS admits that of all the sites proposed, Sand Point would be the most dangerous.

Response: This statement is not correct. Section 6 of Appendix A (Page A-69) provides a comparison of predicted accident rates for candidate sites. It shows that Sand Point has a lower adjusted accident rate than either of the two Tacoma sites.

City of Kirkland

Comment: NOAA vessels pose a potential hazard to the recreational boating traffic and other recreational activities within Lake Washington and the Montlake Cut.

Response: A discussion of the navigational risks of NOAA vessels transitting the Lake Washington Ship Canal is presented in Appendix A. Candidate mitigating measures are presented in Section IV.

D. Harsch
C. Hilgeford
A. Hunt
R. Leed
J. McClelland

Comment: What are the opinions and concerns of the NOAA ship captains about the hazards that may be presented by transiting to Lake Washington?

Response: Six active duty and two retired NOAA Commissioned Officers were queried as to their opinions of the navigational hazards to be anticipated when piloting NOAA ships between Lake Union and Lake Washington. All eight officers hold the rank of Captain, have considerable experience in ship-handling and have had or now have command of a Class I and/or Class II NOAA ship. Their responses were similar in most respects. The officers noted that NOAA ships have transited the canal into Lake Washington a number of times under ideal conditions without incident. It was the unanimous opinion that if routine transits were made of the Lake Union-Lake Washington portion of the canal, it is likely that accidents would occur due to any one, or combination of the conditions as stated in Appendix A of the SEIS. The results of this inquiry bear out the validity of potential hazards as perceived in the navigational risk section of this document.

State Department of Transportation

Comment: If the final site selected requires traffic control measures on any of our highways, the developer will be expected to participate in these costs.

Response: Acknowledged.

Department of the Army
Seattle District Corps of Engineers

Comment: With respect to the U.S. Army Corps of Engineer's areas of responsiblity for flood control, navigation, hydropower and regulatory functions we do not have any comments. Our general comments are as follows:

1. The Final Supplemental EIS should include a specific commitment to mitigative measures for the selected plan.

2. We suggest that the supplemental statement address the following points:

a. The feasibility of including reacreation facilities for the public as part of the overall development plan.

b. The amount of shoreline that would remain accessible to the public for general recreational pursuits out of the total shoreline that the proposed project would occupy.

Response: All mitigative measures designed to reduce potential adverse environmental impacts will be reviewed and considered for implementation prior to making a final decision on site selection.

It is not possible for NOAA to construct public recreational facilities as part of its development of a Western Regional Center since it would be a misappropriation of federal funds. NOAA does, however, encourage public interest and visitation and will provide information stations, interpretive signing and educational displays in several of the buildings. The center grounds and shoreline (except the piers and staging area) will be open to the public. More than 2,100 feet of the total 3,200 feet of the NOAA-owned Lake Washington shoreline will be available for public strolling, jogging, and other limited recreational pursuits. The exact amount of shoreline available at other alternative sites will depend on the particular design for piers and the staging area.

J. McClelland

Comment: There has been previous testimony that fresh-water berthing is no longer particularly advantageous. Why was the subject raised in the EIS?

Response: We are unaware of any testimony in this regard. Fresh water berthing is more attractive than salt water berthing since it reduces corrosion and barnacle growth and eliminates problems associated with tidal variations. However, it is not an overriding factor. The point made in the Supplement (Page A-2) is that this factor is an operational consideration and does not pertain to navigational risk.

Comment: Did NOAA present copies of the investigative staff report of the House Appropriations Committee to URS? I request this document be thoroughly evaluated prior to the preparation of the final EIS.

Response: A copy of the House Appropriations Investigative Staff report dated June 10, 1976 has been provided to URS Company for their consideration. However, the report contains no information on any environmental impact caused by NOAA development so it is unclear how this report will be of use to URS in preparing the Final Supplemental EIS.

Comment: There are statements in the SEIS about NOAA scientists who also receive salaries from the University and grants from NOAA. Do all federal agencies permit their employees to enjoy such benefits and privileges? How can NOAA justify such an excessive expenditure of tax dollars?

Response: No such statements are included in the SEIS. The NOAA scientists holding faculty positions at the University receive no salary for their services. NOAA provides the University with grants, not vice versa.

H. Winter

Comment: The EIS did not include a statement which indicated that a split site would not serve as well or better than a combined site.

Response: As referenced in the supplement, NOAA's "Management Considerations for a Western Regional Center," dated July 1978, addresses the various split site options and their impacts.

Comment: I believe NOAA's overspending, such as the estimated $225,000 for its EIS report and its many other unnecessary expenses to bring ships into Lake Washington, will put a real cog in the wheel for Jarvis' Proposition 13 for the U.S.

Response: Preparation of the Supplemental EIS is estimated not to exceed $135,000 and is required by federal law as a prerequisite to major federal developments such as that contemplated by NOAA.

V. Gunby

Comment: I would urge that the employees of your facility be encouraged to live close to the place of work, and that your parking facilities and programs encourage the use of transit, van pools, and carpools.

Response: NOAA's plans for a Western Regional Center include active programs to encourage employee use of mass transit systems and car pooling and consideration of van pool schemes. Efforts will be made to ensure that adequate public bus service to the center is available and that certain parking privileges will be provided as an incentive for carpooling.

B. Caminiti

Comment: The state has filed a suit in federal court on whose laws will govern the coastline. The Plaintiff is the State of Washington Department of Ecology v. the United States of America, Juanita Kreps. It is No. C78-223V. I would think that this whole hearing and all your progress and processes are and

should be declared moot until the results of that federal trial which will probably go to the Supreme Court is heard. I think your whole processes have no legal merit.

Response: The law suit brought by the State of Washington is unrelated to the environmental impact statement process in the course of which the comment was made; and, whatever the ultimate decision in the law suit, it cannot "moot" the necessity of the environmental impact assessment process which NOAA is now pursuing. Two different federal laws and two different issues are involved.

The law suit involves the interpretation of a section of the Coastal Zone Management Act of 1972 (CZMA) which excludes certain federal lands from a state's coastal zone, and, therefore, excludes them from the direct application of that state's approved coastal zone management program. On the other hand, the environmental impact statement process stems from the National Environmental Policy Act (NEPA) which requires that, before undertaking any action which can significantly affect the environment, the federal agency principally involved must assess the effects of the activity upon the environment and balance those effects against the desirability of proceeding with the activity. The outcome of the law suit under the CZMA has nothing to do with whether, pursuant to the balancing process required by NEPA, NOAA's proposal for a western regional center Sand Point should proceed.

R. Van Moppes

Comment: Why did Seattle Light install a transformer power pad on Sand Point Way outside of the NOAA entry?

Response: The U.S. District Court injunction, dated March 16, 1978, prevented NOAA from dredging and pier construction at Sand Point. NOAA voluntarily halted all construction and design activities with one exception while undertaking an effort to objectively consider other site alternatives. The construction of the North Gate Corridor was well underway at the time the injunction was issued. NOAA believed it was necessary to complete the corridor work since it would seriously disrupt Navy activities if work was suspended. Much of the construction is to isolate Navy and NOAA utility services which require City Light to install an underground vault in Sand Point Way. The transformer pad is an integral part of the corridor work.

R. Dunham

Comment: It is clearly in error for any NOAA official to conclude that the SEIS indicated any preference for consolidation of the ocean-going facilities at Sand Point.

Response: The purpose of the SEIS was not to indicate a site preference for consolidation but to objectively analyze and evaluate navigational risks and environmental assess several alternative sites, including split sites.

U.S. Environmental Protection Agency

Comment: Although the statement maintains that NOAA still prefers to locate the entire facility at Sand Point, it is not clear on what basis this decision was made. We suggest

that the Final Supplemental Environmental Impact Statement discuss NOAA's analysis in more detail.

Response: The introduction indicates that Sand Point is the proposed action, and not necessarily an agency preferance. As stated on P. 1-2 of the Draft SEIS, two NOAA management documents that reconsider the previous decision to consolidate at Sand Point were prepared. These reports conclude that consolidation is preferred to other development schemes, and that such consolidation would be most advantages at Sand Point. The final NOAA decision will be based on consideration of environmental impact, navigational risk, administrative effectiveness, site characteristics, ship activities, economics, accomplishment of agency mission, and public comment.

D. Harsch

Comment: No reference is made to costs, repair or rebuilding the space that NOAA presently occupies.

Response: Of all the space that NOAA presently occupies (294,620 Sq. Ft., excluding Montlake Laboratory) approximately 33% is leased in five different locations. At these locations, expansion is not physically possible due to limitation of additional space. Space presently utilized on NOAA property at Sand Point (50,163 plus 147,500 sq. ft. unheated warehouse) is not suitable for proper laboratories and is inadequate structurally and mechanically, making it uneconomical to modify.

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Appendices

APPENDIX A

NAVIGATIONAL RISK ASSESSMENT FOR CANDIDATE SITES:

NOAA WESTERN REGIONAL CENTER DEVELOPMENT

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July 1978

APPENDIX A

NAVIGATIONAL RISK ASSESSMENT FOR CANDIDATE SITES

In this appendix the sites have been identified by names and differ from those used in the main body of the Supplemental EIS:

EIS	APPENDIX A
North Hylebos	Tacoma North
South Hylebos	Tacoma South
South Mukilteo	Mukilteo

Also in this appendix reference to ports, e.g., the Port of Everett, is in the generic sense, including all facilities, private or public, within geographical confines as outlined by the Corps of Engineers in their various publications (see Appendix 3).

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I. INTRODUCTION

This report is an addendum to the Supplemental Environmental Impact Statement (EIS) prepared by the URS Company for the National Oceanic and Atmospheric Administration. It addresses only the navigational risks associated with the proposed NOAA Western Regional Center Development and for the candidate sites and options. The reader should refer to the Supplemental EIS for details on other respects of the proposed project.

BACKGROUND

This navigational risk assessment was undertaken as a result of a United States District Court injunction (Civil Action Number C77-914M) which, among other issues found the initial Final Environmental Impact Statement dated 30 January 1976 inadequate in its identification and consideration of navigational risks associated with the proposed transit of NOAA vessels through the Montlake Cut into Lake Washington to a proposed site at Sand Point. Additionally, the court ruled that sufficient attention had not been directed at alternate sites and options. Hence, this study is intended to identify and consider in detail all possible navigational risks associated with transit of NOAA vessels into any site or sites in Lake Washington; and to compare the navigational risks for all proposed sites and options, after appropriate mitigation measures have been applied.

APPROACH

Initially, the court ruling and all supporting evidence, was reviewed. Additional information from the public files as well as those from within NOAA, were examined in an effort to assess the perceived risks and to ensure full disclosures of known or suspected risks. A list of documents reviewed is given in Appendix 1. Additional inputs were obtained from interviews and/or contacts (primarily telephonic) with a variety of organizations and persons who had either expressed previous interest and/or concerns or who, in the course of the analysis, were identified as data resources. These organizations and individuals are shown in Appendix 2. These inputs, including continuing contact within the NOAA organization plus standard references, listed in Appendix 3, then provided the basic data inputs for the analysis.

The navigational risk assessment methodology used required: establishing a baseline of the present operations, usages of the water, accident rates, and NOAA vessel characteristics; next, all risks for each site were identified qualitatively emphasizing the location of potential accidents,

the likelihood of such accidents occurring, and the probable magnitude of consequences of any such accidents; then mitigating measures which might be incorporated into the project to reduce either the likelihood or the magnitude of the consequences of potential accidents were developed; a quantification, to the extent possible, of the mitigated risks was done; finally, the relative risks at each site compared.

The intent of this study was to provide an objective analysis which, in as much detail as possible, would rank risks, providing useful information to the decision-maker.

Data which were not fully documented were corroborated by one or more of the "experts". Where disagreement was identified, further investigation was undertaken to ensure that findings were either essentially correct or required modification.

CANDIDATE SITES AND OPTIONS

Three possible options were considered: a consolidated site in which all land based and water based operations are at one site; a split site configuration in which the water based (that is ships and support facilities) operations are at a separate location from the land based operations and a split site configuration with provision of a single berth staging pier adjacent to land operations at Sand Point. This last option, which applies only to split sites within the Lake Washington Ship Canal (LWSC), envisions the berthing of the fleet at one location with an occasional ship movement to Sand Point to expedite project work on the ship involved.

Table 1 lists the proposed sites and possible options. Table 1 also makes a distinction between those sites with direct access, that is, located on Puget Sound and indirect access, that is, requiring movement through the Chittenden Locks and a portion or all of the Lake Washington Ship Canal.

The advantage of a location in the freshwaters of LWSC and/or Lake Washington, are primarily two-fold: tidal variations are absent, eliminating certain problems associated with such variations; and freshwater tends to reduce corrosion and barnacle problems. On the other hand, saltwater and tidal candidate sites are always available without any requirements to transit a lock system. However, these factors are operational concerns and do not pertain to navigational risks.

Details on the candidate sites will be presented in subsequent sections. However, it should be noted that greater attention will be provided in this analysis to those candidate sites within the LWSC and Lake Washington for two reasons. First, the major concern of the court ruling had to do with

TABLE 1. CANDIDATE SITES AND OPTIONS

Candidate Site	Consolidated	Split	Split with Staging at Sand Point
Direct Access to Puget Sound			
Everett	X		
Mulkiteo	X		
Manchester	X		
Tacoma North	X		
Tacoma South	X		
Indirect Access to Puget Sound			
Sand Point	X		
Kenmore	X		
Lake Union			
o PMC (present)		X	X
o Dry dock		X	X
Salmon Bay		X	X

sites within this geographical area. Second, the navigational risks encountered within the LWSC, in particular, are of a different type and degree than those identified elsewhere in more open waters. Hence, only by a detailed analysis of this particular waterway could an adequate assessment be made.

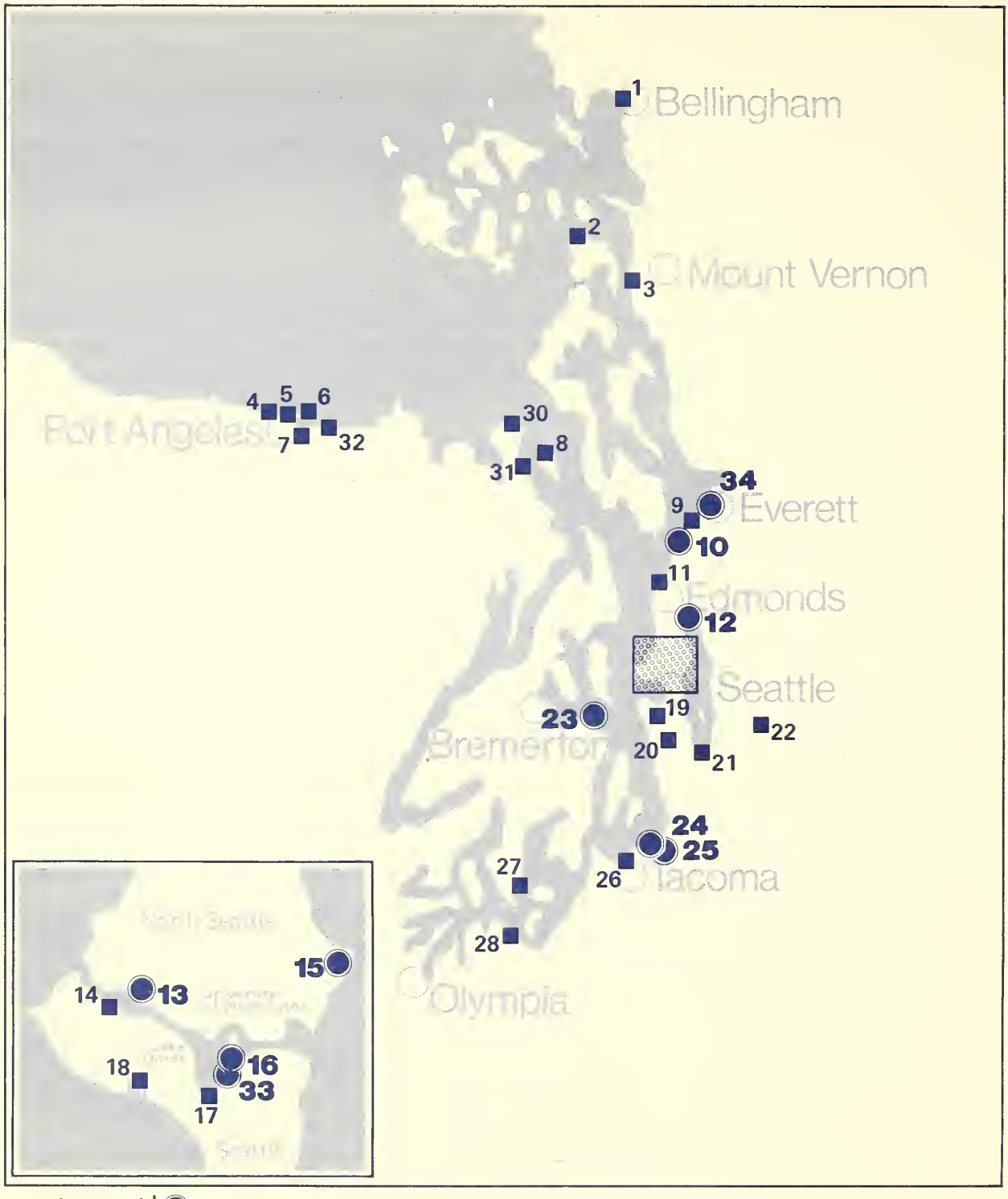
CANDIDATE SITES

The candidate sites and the location of the candidate sites are shown on Figure 1. All sites are reached by a transit of the Strait of Juan De Fuca through Admiralty Inlet into Puget Sound proper. From there, just past Point No Point, vessels move to the respective candidate sites.

Puget Sound, in general, offers sheltered berths and deep waters which provide for minimal navigational risks into and within Puget Sound itself. The climatic regime within Puget Sound is quite constant. Occasional storms can sustain winds of 40 knots which, in long fetches, can create waves of considerable magnitude. Fog occurs regularly with peak times in the winter months. It is generally a night and early morning fog which breaks by midday. Puget Sound also has a number of regularly scheduled ferry services. The Coast Guard maintains a Vessel Traffic System (VTS) including Greater Puget Sound and extending down to Tacoma, but not including the Lake Washington Ship Canal. This VTS includes designated traffic lanes, a variety of navigational tracking devices and a central control center in Seattle which maintains contact with vessels and advises them.

The most northerly candidate site is at the Port of Everett, which is reached by a transit through Possession Sound into Port Gardener and then into East Waterway. Logging, lumber, and paper-related industry dominates the waterfront on Port Gardener and the related shipping activities. Several of the 17 piers in this area accommodate large ships and there is a 30-foot dredged channel, about 800 feet in width, into the East Waterway. Just north of the proposed site, the Snohomish River begins with a dredged channel which accommodates an additional number of shallow draft piers and log rafting activity. About one-third of the traffic each year is in rafted logs, most of which are ultimately exported. Total traffic in 1976 was just over 4 million tons. Tides and weather are similar to all other points in the Puget Sound area although because of its closer proximity to the ocean winds tend to be somewhat higher. Small boating activity is present but not unusually heavy nor concentrated near the commercial shipping activity. The entrance way is broad and visibility is good.

The second candidate site is just south of Elliott Point and the small town of Mukilteo. The land portion of the site is located on a bluff above Possession Sound and the proposed piers would extend into the Sound. There is no present industrial waterside activity in the area and, because of the residential development to the north and south, none is likely in the future. The nearest support activity for marine services is Everett;



Legend
- Sites Selected for Environmental Analysis
- Potential Alternative Sites (Numbers refer to Table 1-1)

Note: Site No. 29 (Potential) located at Astoria, Oregon

5 0 5
Scale in Miles

Figure 1

Sites Considered for NOAA Regional Center

however, most support would be drawn from Seattle. In order to reach the site of the proposed piers from the land side, it would be necessary to cross over the two main tracks of the Burlington Northern Railway which lie at the bottom of the bluff. The inshore waters are shallow so that considerable dredging to allow bringing in larger ships would be required. Because of the almost north-south alignment of Possession Sound, storm winds over the long fetches require a protected mooring; hence the need for breakwater into the proposed site is indicated. Climatically, this site is very similar to the Port of Everett.

The Manchester site is reached by continuing down the main channel shipping lanes past the Port of Seattle, then veering west toward Bremerton. This site, which is just at the beginning of Rich Passage, does not present any special problems in its approach, although the ebbtides through Rich Passage produce some of the heavier currents (over 1 knot) in the Puget Sound area. Rich Passage, which has several visible shoals and one very sharp turn, is regularly used by the Seattle-Bremerton Ferry, and to a lesser extent by naval vessels from the Bremerton Naval Shipyard. Boating traffic is generated from a number of private piers on adjacent residential areas but no large marinas are close by.

The proposed Manchester site in Clam Bay (a large, very shallow bay with several hundred yards exposed at low tide) would necessitate either a great amount of dredging or a very long pier. Presently an aquaculture facility is located in the Bay. At this site additional navigational aids would be required and, possibly, a breakwater. Support services would be obtained from Seattle.

The two other sites with direct access to Puget Sound are located in the Hylebos Waterway in the Port of Tacoma.* These sites are reached by a continuation on the traffic lanes into Commencement Bay where the Hylebos Waterway lies to the extreme north of the Bay. The Port of Tacoma, the second largest port in the State of Washington, handled just

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*As used in this report, and following the terminology and jurisdictional boundaries set forth by the Corps of Engineers in their publications (e.g., Port Series No. 35 and Waterborne Commerce of the U.S.), the Port of Tacoma includes all commercial facilities and shipping activities, public and private, within Commencement Bay and waterways connecting thereto. The "Port of Tacoma" in a more restricted sense refers to the municipal corporation which owns and operates several facilities within the Port of Tacoma. Unless specifically called out, all references in this study are to that larger entity which includes waterborne traffic using both public and private piers. The Corps of Engineers Series 35, "The Ports of Tacoma, Grays Harbor, and Olympia, Washington," Revised 1975, provdes detailed information on pier type, ownership, location, etc. within the Port of Tacoma. "Waterborne Commerce of the U.S.", published annually by the Corps of Engineers, provides information, by vessel class, on port calls to Tacoma, but not the individual waterways.

over 10 million tons of vessel traffic in 1976; rafted logs accounted for 2 percent of this total. About 200,000 passengers were moved by ferry from the south side of Commencement Bay; however, no interface with traffic following the designated traffic lanes (in East Passage) to the Hylebos Waterway occurs. Traffic is not growing greatly although the Port is aggressively attempting to increase trade.

The Hylebos Waterway, including piers fronting on Commencement Bay, encompasses 32 piers according to the Corps of Engineers (1975). Thirteen piers can accommodate ocean-going vessels; commodities handled at these facilities include chemicals, petroleum, and logs. Naval vessels also use piers at the entrance of the Waterway. Seven piers are used by firms concerned with ship repair, fitting or building. The remaining shallow draft piers are used for barge or tug mooring, or for movement of commodities (logs, fuel oil, sand and gravel). Ships using the upper portion of the 2.8 mile Waterway utilize a turning basin at its terminus.

The North Tacoma site is about a mile above the entrance to the waterway on the north shore and would provide sufficient waterside space for NOAA vessels after construction (involving both dredging and filling). The 190 foot wide channel with a project depth of 30 feet is heavily used by large ocean-going cargo ships.

The South Tacoma candidate site is reached by movement through the East 11th Street Bridge to a distance about 2 miles above the entrance to the waterway. The waterway narrows to 160 feet above the bridge while the project depth remains at 30 feet. A number of industrial sites are found beyond this point and a turning basin has been established to accommodate large vessels. The East 11th Street Bridge was constructed in the mid-30's, and because of its age, has a history of failure. However, extensive maintenance activities are scheduled for the bridge to ensure prolonged life and assured operation for the next decade. In case of bridge failure, it is left in the open position to allow access by ships to the piers east of it. This bridge, which is operated by the State of Washington, is tended 24 hours per day.

The South Tacoma site would require both excavation and dredging in order to provide adequate waterfront footage in the limited space available.

The remainder of the candidate sites are all reached through the Lake Washington Ship Canal (LWSC), that is, by indirect access. (The LWSC is considered by the Corps of Engineers, as a part of the Port of Seattle -- a generic entity not to be confused with the "Port of Seattle," a municipal corporation which owns and operates a number of piers on Elliott Bay, in the Duwamish Waterway and in the LWSC. Data for the LWSC are separated by the COE from that for the Port of Seattle within Elliott Bay.) The Lake Washington Ship Canal was constructed initially to promote industrial development on Lake Washington by allowing access by ocean-going vessels.

The LWSC is entered by a large lock (a smaller lock is used for smaller vessels) which provides a constant freshwater level.* Lake Washington, which requires transit of the entire LWSC, was mostly heavily used industrially during World War II and shortly thereafter. A brief resurgence in usage occurred in the early 1970's in support of the Aleyska pipeline. Although accurate records as to exact usage were not developed, it is known that the LWSC was used by medium-sized freighters and tankers, most of which were larger than the largest of the NOAA vessels. However, following the cleanup of the waters of Lake Washington, industrial activity in Lake Washington itself has decreased markedly as have the transits of the LWSC to it by ocean-going vessels. At the same time, the residential and recreational activities on Lake Washington have increased and have extended to some considerable extent into the eastern reaches of the LWSC. Recreational vessels also use the LWSC to reach the open waters of Puget Sound. Boating traffic density, at peak periods, is considerably higher in the restricted waters of Lake Union.

Climatic conditions within the LWSC and Lake Washington are similar to those found elsewhere in the Puget Sound area. Within the locks, tidal variations are absent and currents are weak or negligible except in a few areas which are well known to the knowledgeable sailor. Much of the LWSC is sheltered by adjacent hills so that winds are much lower than in the open waters of Puget Sound. To a somewhat lesser extent, Lake Union and Lake Washington also are sheltered from prevailing winds. The two cuts in the LWSC, which pose constraints on maneuvering room for larger vessels, are less susceptible to beam winds which could increase maneuvering difficulties. According to Nickum and Spaulding (Sept. 1, 1977):

> "It must be noted, however, in the most restricted part of the Lake Washington Ship Canal, the Montlake Cut, where the banks on either side rise to a height of approximately 60 ft., the vessel's hull and superstructure are completely blanketed from beam winds. Any sailor attempting to sail through the cut without power has knowledge of this fact.
>
> The other restricted area of the Lake Washington Ship Canal is from the Fremont Bridge to the site of the old Northern Pacific Railroad Bridge which has its banks lined with tall poplar trees and industrial buildings. These obstructions shield the vessel's hull and superstructure from beam winds. Observations show that prevailing winds tend to align with the longitudial axis of the canal rather than across it which minimizes the problem of ship maneuverability while transiting the canal."

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*The limiting dimensions on the Hiram M. Chittenden Locks are 29.4 feet depth and 80 feet width. The Locks are normally closed down with adequate notice, for about two weeks each year for maintenance. Other major constraints within the LWSC are the Fremont Cut and the Portage (Montlake) Cut, both with controlling depths of about 27 feet and channel width of 105 feet.

Vessel traffic into LWSC, which is part of the Port of Seattle, fluctuates considerably; in 1976 it amounted to almost 1.4 million tons, of which almost 400,000 tons was rafted logs. On the average about 40 percent of this traffic moves on to Lake Washington, and consists almost entirely of log rafts and sand and gravel barges. Commercial activity within the LWSC is concentrated in Salmon Bay just inside the Chittenden Locks, and in Lake Union, the site of the present NOAA ship base.

Transit of the LWSC requires passage through one or more bascule (draw) bridges. Because of the heavy vehicular traffic on these bridges, there is an inherent conflict between traffic in the LWSC and that on the surface. Hence, bridge tenders, who are employees of the City of Seattle, must use best judgment in traffic control and may, on occasion, delay waterborne traffic. Officially, vessels of less than 1,000 tons cannot request a bridge opening during the peak vehicular traffic hours of 7 to 9 a.m. and 5 to 7 p.m. on weekdays. As a matter of self-imposed policy NOAA vessels do not request bridge openings, during these hours.

The first candidate site within the LWSC is on the north shore of Salmon Bay just west of the Ballard Bridge. This is a split site alternative; that is, all the ships would be based here whereas land operations would be at Sand Point. As an option, an occasional ship from this mooring might proceed to a staging pier at Sand Point. Water depths are adequate at this candidate site and maneuvering room, after construction, would be adequate for NOAA vessels.

Two candidate split sites are located on Lake Union, one at the existing Pacific Marine Center (PMC) operation on the southeast shore of the lake and the other just adjacent to the south of it at the existing Lake Union Drydock Company. Both sites are accessible and both could also be used optionally as split sites with occasional passage to a staging pier at Sand Point.

The next candidate site is a consolidated operation at Sand Point. A possible option for this site is that of a single staging pier which could accommodate one or two NOAA vessels being equipped for research efforts. In both the consolidated and staging pier concept, vessels would be moored to the north of Sand Point in a relatively sheltered and accessible area. Dredging would be required for the piers.

The final site proposed is at Kenmore at the north end of Lake Washington. This is proposed as a consolidated site with all ships moored there. Presently there is a fair amount of tug and barge activity (primarily sand and gravel), pleasure boating (including a large marine sales operation), and a seaplane base located near the candidate site. The lake is quite shallow at this point and considerable dredging would have to be undertaken to permit mooring of NOAA vessels in this location. Also, the Sammamish River feeds into Lake Washington at this point so that fairly frequent maintenance dredging would be required.

The characteristics of the candidate locations discussed, in relation to navigational concerns, are summarized in Table 2. In most cases only a relative ranking is given since the table is intended to provide the reader with an overview of the candidate sites. Additional information can be obtained from the Supplemental EIS and from standard references shown in Appendix 3.

EXISTING AND PROJECTED TRAFFIC PATTERNS

Figure 2 shows the annual volume of commercial freight and passenger traffic for the various major ports on or about sites which are under consideration for NOAA facilities. These data covering the years 1971 to 1976 show, in general, a modest growth pattern for the Ports of Seattle and Tacoma, with a slight decline for the Port of Everett and for the Lake Washington Ship Canal portion of the Port of Seattle. The Corps of Engineers indicates that no substantial growth in commercial traffic is anticipated at any of these ports. However, a rather consistent growth is noted for the passenger volumes carried by the numerous ferries in the Port of Seattle.

From Figure 2 it is obvious that commercial traffic is greatest at the Port of Seattle; most of this traffic concentrated in Elliott Bay and less than 15 percent in the Lake Washington Ship Canal. These commercial transits within the Lake Washington Ship Canal and Lake Washington have been further differentiated using a Corps of Engineer printout (Waterborne Statistics, New Orleans). Figure 3 shows values normalized for 1972. Actual values can be obtained by taking the 1972 base, shown on the figure, and multiplying it by the appropriate normalized values for any given year. For example, the number of commercial transits into Lake Union from Puget Sound in 1976 was about 7,400 (8,176 x .9 = 7,358) while those commercial transits from Lake Union to Lake Washington were only about 1,900 (1,007 x 1.9 = 1,913). Similarly, the recreational transits through the Chittenden Locks exceeded 77,000 in 1976.

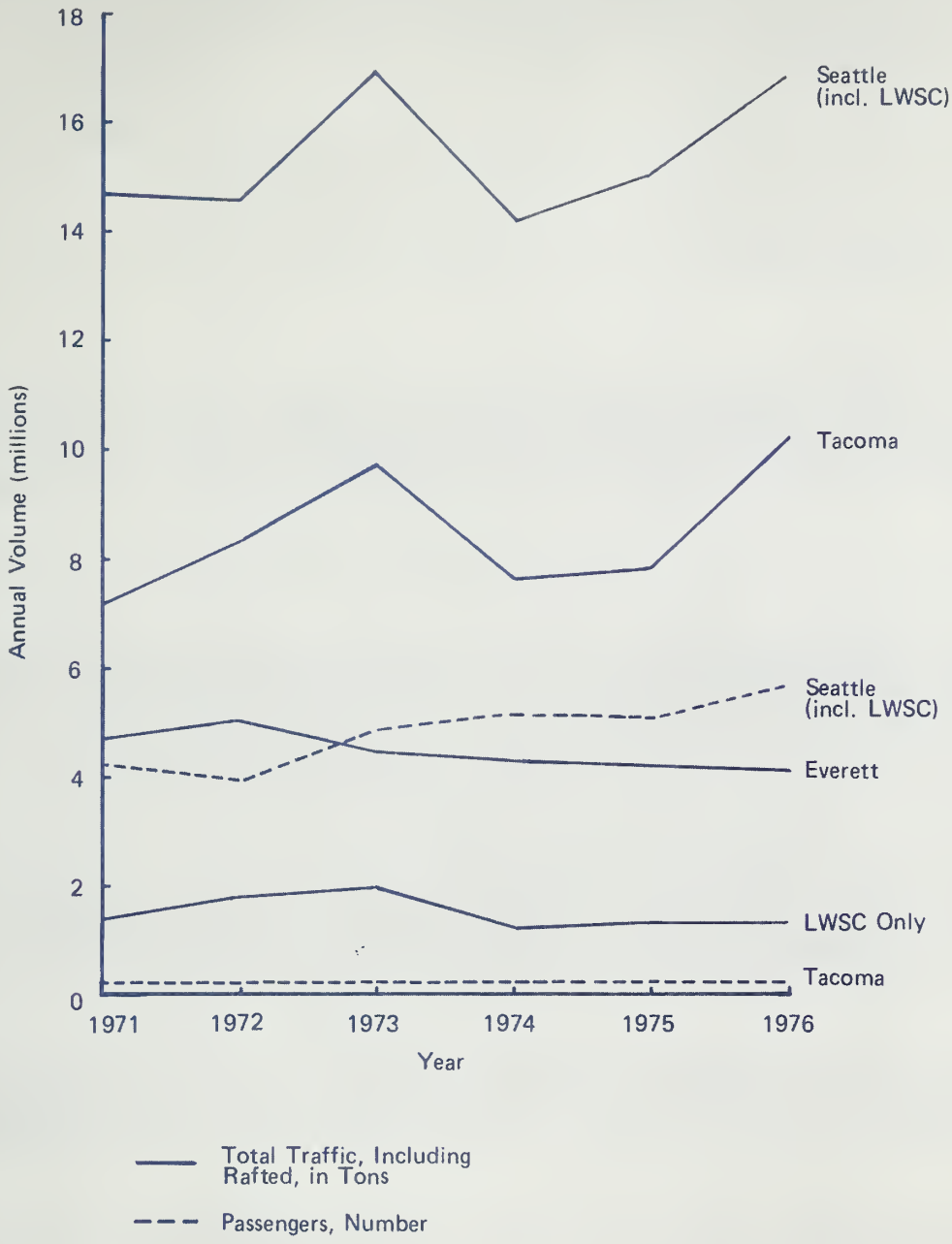
Figure 3 is valuable in indicating trends in the waterway usage. Thus, commercial transits from Puget Sound to Lake Union and from Lake Union to Lake Washington have declined at about the same rate in the last few years. (The marked increase in the transits from Lake Union to Lake Washington from 1972 to 1974 was almost entirely attributable to activity associated with construction of the Alaskan pipeline). In general then, commercial usage within the Canal (including Lake Union) and within Lake Washington is dropping, although annual variations can be appreciable. On the other hand, recreational usage of these waters is increasing as can be seen in the increased recreational transits through the Chittenden Locks between 1972 and 1976.

The increase in the annual number of bridge openings over a 5 year period (comparing 1972 to 1977) also attest to the increased use of the LWSC:

Table 2 BASELINE CHARACTERISTICS OF CANDIDATE LOCATIONS PERTAINING TO NAVIGATIONAL CONCERNS

	Direct Access					Indirect Access			
Characteristic	Everett	Mukilteo	Manchester	Tacoma North	Tacoma South	Kenmore	Sand Point	Lake Union (both)	Salmon Bay
Approach	open	open	open	190' channel	160' channel	restricted	restricted	restricted	restricted
Site Requirements									
o Initial dredging/ fill	much	much	much	much	much	much	some	little	little
o Maintenance dredging requirements	some	some	much	minimal	minimal	much	minimal	minimal	minimal
o Navigational aids	advised	advised	advised	adequate	adequate	advised	advised	adequate	adequate
o Breakwater	no	yes	yes	no	no	no	no	no	no
Climate and Hydrographic									
o Wind (1)	above average	above average	average	below average	below average	above average	above average	average	below average
o Fog (2)	above average	above average	above average	average	average	below average	below average	below average	below average
o Currents	low	low	above average	low	low	very low	very low	very low	very low
o Tidal range, ft.	7.4	7.5	8	8.1	8.1	negligible	negligible	negligible	negligible
Traffic									
o Commercial activity (3)	some	low	some	much	much	low-some	low	some	some
o Recreational boating (4) activity	some	low	low	some	some	very heavy	very heavy	heavy	heavy
o Ferry crossings	some	none	yes	minimal	minimal	none	none	none	none
o Bridge openings required	none	none	none	none	1	5	5	3	1

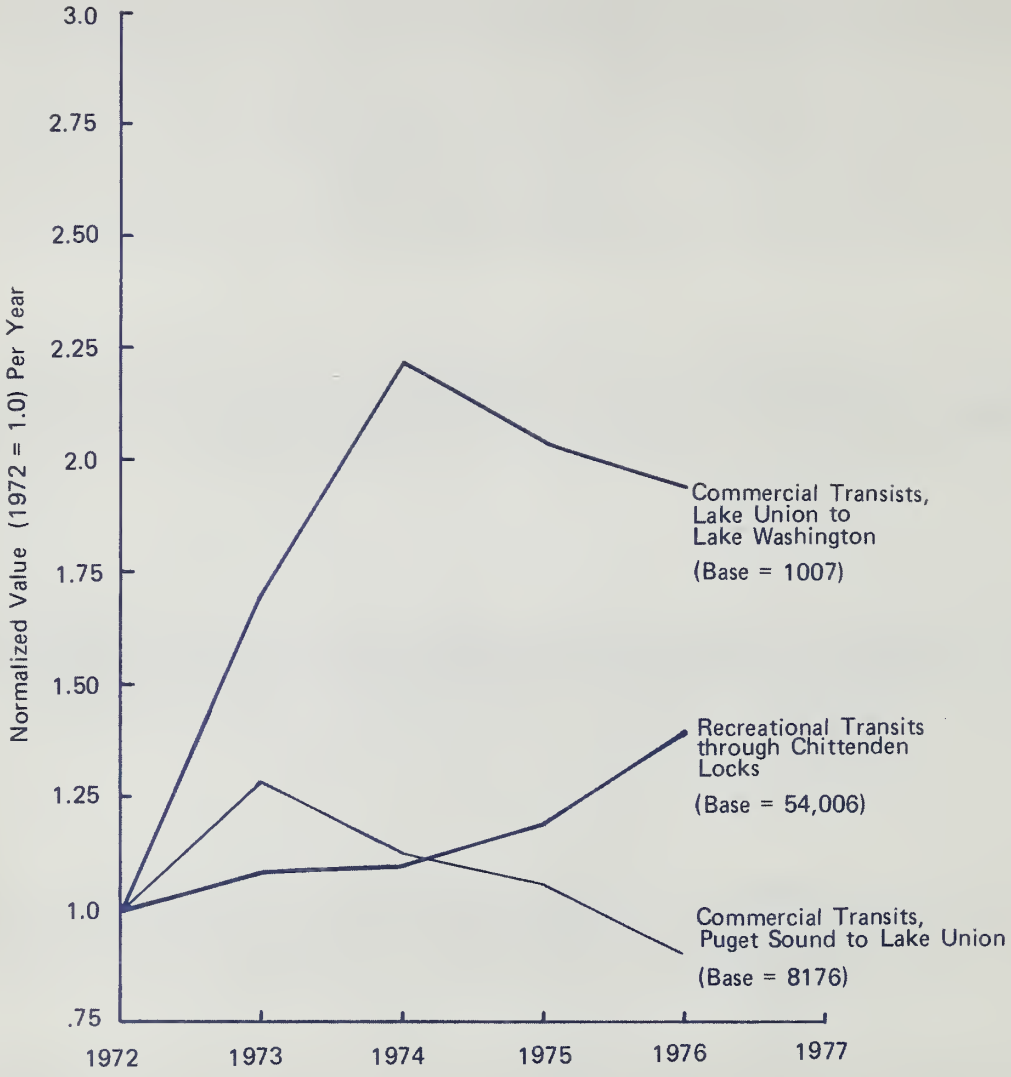
(1) In the Puget Sound area winds are typically from the SW to SE from September to April and from the NW to N in late spring and summer. Intense storms, almost always from the south, can generate substantial winds of up to 40 knots. Average winds are highest in northern Puget Sound, decreasing with movement southward.
(2) Fog causes visibility problems about 25-40 days per year in the Puget Sound area, with the least fog in Puget Sound proper.
(3) Commercial activity for existing ports is discussed under Baseline. Further information can be obtained from the current U.S. Coast Pilot 7, Pacific Coast, available through the National Ocean Survey.
(4) Refers to total amount of boating activity which may be encountered in summer months in transit to candidate sites.



Source: Waterborne Commerce of the United States, 1976, Corps of Engineers.

Figure 2

Annual Volume of Commercial Freight and Passenger Traffic for Various Ports



Sources: City of Seattle Bridge Maintenance Department and Corps of Engineers Waterborne Statistics Division, New Orleans.

Figure 3

Indices of Lake Washington Ship Canal Usage by Commercial and Recreational Vessels, 1972-1976

Bridge	Incremental Increase
Montlake	2,677
University	3,530
Ballard	3,166
Fremont	4,796

The incremental increases, in view of the almost stable commercial traffic volume, are attributed to increased recreational traffic. (The appreciably higher incremental increase for the Fremont Bridge is related to its lower vertical clearance which required smaller boats to request an opening.)

An estimate of projected recreational boat ownership in the LWSC has been developed. This projection (Table 3), based on a study done by the Washington State Parks and Recreation Commission in 1968, lists projections for 1977 and 2000, based on an estimated growth of 3-9/16 percent per annum to 1980 and 3-3/8 percent per annum thereafter. Thus, by the end of the century boat ownership within the LWSC and Lake Washington is expected to more than double, with smaller boats continuing to predominate. The placement of these craft is, of course, uncertain but, their use in the eastern portion of the LWSC and in Lake Washington seems to be becoming increasingly popular.*

Vessels owned by NOAA and predecessor agencies have been using the LWSC to reach their home port at Lake Union for well over 30 years. Existing vessels which will be described subsequently in more detail, range in size from less than 100 feet to 303 feet in length and, for ease of designation, are subdivided into five different classes, Class I being the largest.** This fleet of 10 vessels averages about six transits per month as shown in Figure 4. The marked decrease in transits in December and January reflect the usual practice of having the ships "home" for the holiday season. Figure 5 has been prepared which shows by class of ship, the number of transits through the LWSC each quarter. Some interesting variations are revealed. Based upon this 3-year record, the Class I and Class II ships use the LWSC most frequently in the third quarter (July, August, and September) and the least in the first quarter (January, February, and March). On the other hand, the smaller Class III

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*For example, the University of Washington reported that from July 1, 1976 to June 30, 1977, there were approximately 132,000 individual rentals of sailboats and canoes from their facility located at the west end of Union Bay Reach. These rentals involved 370 sailboats, canoes and other small craft. By comparison, in the early 50's this facility had 20 to 30 canoes for rent.

**PMC currently has no Class IV vessels quartered in Seattle.

TABLE 3. PROJECTIONS OF CURRENT AND FUTURE BOAT OWNERSHIP, BY CLASS, IN AREA 8 (the LWSC and Lake Washington)

Type	1977	2000
Motorboat		
o Inboard	5,400	11,600
o Outboard	28,000	60,200
Sailboats		
o Auxiliary	440	950
o w/o power	1,870	4,000
Miscellaneous (canoes, etc)	19,600	42,200
	53,310	118,950

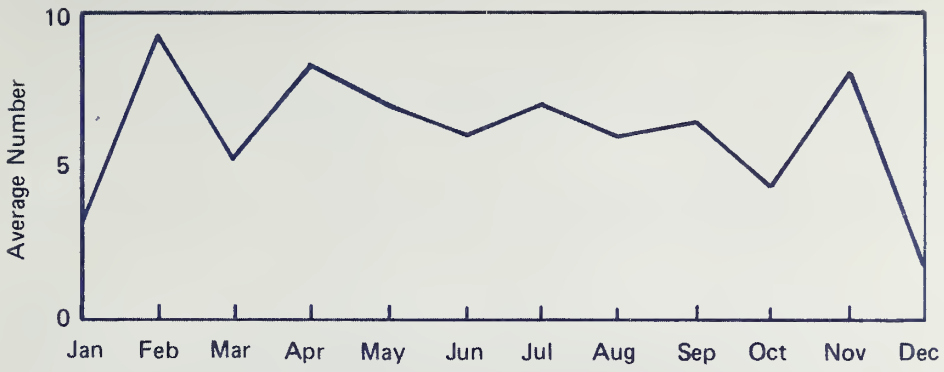
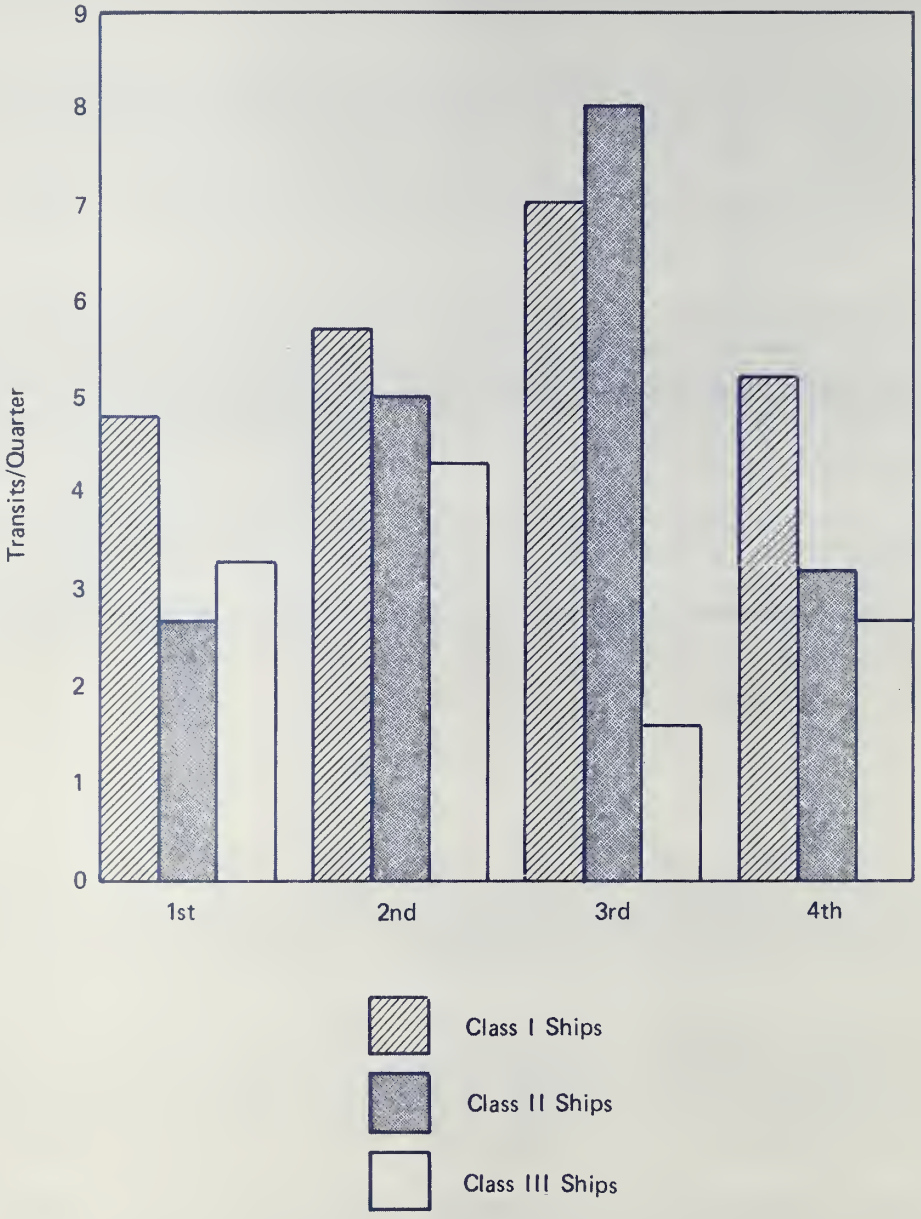


Figure 4

NOAA Vessel Transits in Lake Washington Ship Canal



Source : Pacific Marine Center, NOAA

Figure 5

Average Transits Per Quarter by NOAA Vessel Class to Lake Union

ships peak in the second quarter (April, May, and June), and are lowest in the third quarter. The two Class V ships (not shown) have maximum transits in the winter months.

The historical data in Figure 5, although indicative for the 3 year period, are limited in forecasting future use patterns and total usage because of changing program requirements. For example, in the FEIS, p. 16, transits reported are:

1972	100 (approx.)
1973	100 (approx.)
1974	48

Whereas more recently total transits were:

1975	82
1976	67
1977	69

Further, the number of ships in the NOAA fleet fluctuates somewhat, although the maximum number proposed for the forseeable future is 12 as against the current 10. For purposes of projection through the year 2000, the 6 year average (73.4 annual transits) was used as a base and a maximum estimate of 120 transits (60 port calls) per year was determined. This value of 120 transits per year, representing a "worst case" condition, was applied to the use pattern, by quarter, shown in Figure 5, in subsequent analyses.

ACCIDENT BASELINE

Commercial Vessels

With the cooperation of the Marine Safety Division of the 13th Coast Guard District, accident reports for the Greater Puget Sound waters (reports from as far north as Anacortes and as far south as Tacoma) were surveyed for the period 1974 through 1977 by O. Leon Crain of URS. In this initial assessment all commercial vessel accidents, including those involving freighters, tankers, tugs, barges, and fishing vessels, were considered. (In a later review of the Coast Guard files, discussed subsequently, the same files provided more detailed accident information on dry cargo vessel (with draft >18 ft.) accidents for the Ports of Everett, Seattle and Tacoma.) By initially considering all commercial accidents, rather than just dry cargo vessels ("freighters") which are most comparable to NOAA vessels, the cause and location of accidents could be better defined (i.e., by increasing the data base to include all accidents - not just the 18% represented by freighters - more information could be deduced). Of interest is the type of ship accidents which were found. Table 4 shows the percent of total accidents due to

TABLE 4. CHARACTERIZATION OF SHIP ACCIDENTS OCCURRING IN GREATER PUGET SOUND

Vessel Type	Typical Vessel Size, tons	Percent Accidents Due to - Ramming	Grounding	Collision	Fire	Other	% by Vessel Type
Tug	100-500	32	16	24	2	26	35
Barge	1,000-5,000						
Freighter	>10,000	53	3	22	16	6	18
Tanker	>10,000	100	--	--	--	--	3
Fishing Boat	<50	9	21	30	21	19	26
Ferry	1,000-5,000	65	18	5	--	12	10
Other	--						8
							100

Source: 13th Coast Guard District and URS.

various causes and attributable to various vessel types. Freighters which, of the commercial categories, are most similar to NOAA vessels, accounted for 18 percent of the total accidents.* A majority (53%) of freighter accidents were due to ramming; 22 percent to collision with other vessels; 16 percent to fire; 3 percent to grounding; and 6 percent to miscellaneous other causes.

Commercial ship accidents, based on the data for Greater Puget Sound, do not vary greatly on a monthly or seasonal basis (Fig. 6). A similar analysis indicated that the average number of accidents remains almost constant throughout each 24-hour day suggesting that nighttime movement is relatively safe.

Table 5 shows the annual frequency of ship accidents, based on these same files, and their cause at several locations thoughout Puget Sound. Of particular interest is the breakdown of accidents by cause, within the LWSC. Table 5 can not be used, however, to directly determine accident rates for freighters alone.

Casualty (i.e., accident) rates for freighters have only in recent years been the subject of statistical correlation (tankers, because of the concern with oil spills, have been more thoroughly studied). Recently the Oceanographic Institute of Washington made a study of freighter accident rates which was useful in the present study.**

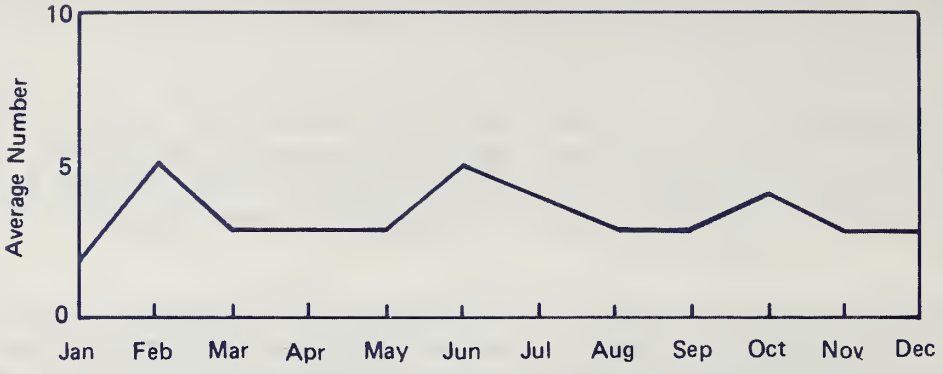
In the OIW study the accident rates for a number of major (including Greater Puget Sound) and small port systems were determined, using Coast Guard data, and a relationship between the number of port calls and the number of accidents was determined.*** The relationship established is of the form:

---

*NOAA vessels are substantially different from commercial vessels in many respects, particularly in propulsion. Unfortunately, research vessels, such as the NOAA fleet, are too small in number to appear as a separate category in Coast Guard statistics. The choice of freighters, upon which a good statistical base is available, is a reasonable alternative, since freighters share the same general vessel configuration as do larger NOAA vessels. Ocean-going passenger vessels, although more similar to research vessels, again have a very small statistical base -- especially in Puget Sound. For further detail see Appendix 4.

**DuPont Navigational Risk Assessment, Report to Weyerhaeuser Company by the Oceanographic Institute of Washington (OIW), September 1977, also addendum dated 22 May 1978.

***It has been found that traffic density as measured by port calls, correlates more closely with number of accidents than do other indices such as cargo tonnage. One port call consists of two transits (inbound plus outbound).



Source: 13th Coast Guard District and URS.

Figure 6

Commercial Ship Accidents in Greater Puget Sound

Table 5 AVERAGE ANNUAL FREQUENCY OF COMMERCIAL VESSEL ACCIDENTS, BY CAUSE, AT VARIOUS LOCATIONS*

LOCATION	RAMMING			GROUNDING	COLLISION	FIRE	WEATHER	CAPSIZED	OTHER	TOTAL	% BY LOCATION
	PIER/DOCK	BRIDGE	SUBMERGED OBJECTS								
Puget Sound	X	X	X	X	X	X	X	X	X	16.3	41.8
Seattle											
Elliott Bay	X	X	X	X	X	X	X	X	X	5.3	13.6
Duwamish	X	X	X	X	X	X	X	X	X	3.0	7.7
LWSC											
Shilshole Bay	--	--	--	.25	--	.25	.25	--	.25	1.0	2.6
Channel	--	--	.25	.25	1.0	1.0	--	--	.25	2.7	6.9
Lake Union	--	--	--	.25	--	.25	--	--	--	.5	1.3
Lake Washington	--	.25	--	.25	--	.5	--	--	--	1.0	2.6
Tacoma	1.5	1.25	.25	--	.25	.25	.5	.25	.5	4.7	12.0
Mukilteo	.25	--	--	--	--	--	--	--	--	.2	0.5
Other**	X	X	X	X	X	X	X	X	X	4.3	11.0
TOTAL	9.0	3.2	2.5	6.5	5.2	4.5	2.0	.7	5.4	39.0	
% by Cause	23.1	8.2	6.4	16.7	13.3	11.5	5.1	1.8	13.8		100.0

NOTE: X squares indicate data was not analyzed; dashes represent zeros.

*Average number of accidents per year (1974-1977), from U.S. Coast Guard files, 13th District, for all commercial (i.e., cargo, passenger, tanker, ferry, barge, tug, and fishing) vessels.
**The Port of Everett, included here, reported 0.75 accidents per year.

Source: 13th Coast Guard District and URS.

Accidents = K (number of port calls)

Where: K = 0.0016 for smaller port systems (< 1,500 port calls/yr)
K = 0.0035 for larger port systems (>1,500 port calls/yr)

K is normally expressed as accidents/1,000 port calls, e.g., 1.6 accidents/1,000 port calls.

The value reported by OIW for the Puget Sound Port system (which includes all ports, both large and small, within the waters generally referred to as Greater Puget Sound) was 3.6 accidents per 1,000 port calls (that is, K = 0.0036). However, to better differentiate accident rate patterns which might exist within this port system, particularly as related to candidate sites, more detailed information on ship accidents was obtained in a second examination of the Coast Guard files pertaining only to accidents to dry cargo vessels (freighters, bulk cargo carriers, etc.) with drafts of greater than 18 feet. Further, only accidents relating to ramming (bridges, piers, or other objects), collision with another vessel or floating object or grounding were considered, since such accidents are the best indices of operational constraints, such as fog, erratic currents, narrow channels, etc., associated with a particular port. Accidents involving collision, ramming or grounding (C/R/G) were identified for the Ports of Seattle, Tacoma, and Everett. A list of these accidents is shown in Table 6. The table includes the Coast Guard file number (files are available for inspection at the Marine Safety Office of the 13th Coast Guard District at Pier 26 in Seattle); locale and the location of the accident keyed to maps (Seattle, Fig. 7; Tacoma, Fig. 8); the vessel name, whether assisted by a tug at the time of the accident or not; the type of casualty; and finally, the total monetary damage to both the vessel and other property caused by the accident.

These data for C/R/G accidents were used to calculate accident rates for this 4-year period, for the identified ports, as shown in Table 7. Accidents have been categorized as either minor, that is, damage of between $1,500 and $10,000, or major, that is, damage exceeding $10,000. In addition, other types of accidents which included those involving fire or mechanical failure on the vessel resulting in damage only to the vessel itself were identified; these, following the OIW practice, are included as a part of the overall accident rate for the port. The accident rate was then calculated for each category; that is, minor, major, and overall, as shown. Not unexpectedly, the accident rates for the larger Ports of Seattle and Tacoma were well above the average found for Greater Puget Sound while that for the smaller Port of Everett was well below.

The accident rate developed for the Port of Seattle was not applied to the LWSC which is physically removed from Elliott Bay and has a different use and accident pattern (although the LWSC accounts for about 15% of all port calls to the Port of Seattle - according to the Corps of Engineers - no freighter accidents were reported in its confines, i.e., from Shilshole

TABLE 6. DRY CARGO VESSEL (>18 ft. draft) ACCIDENTS (RAMMING, GROUNDING AND/OR COLLISION) IN THE PORTS OF SEATTLE, TACOMA AND EVERETT FOR THE PERIOD 1974-77.

Coast Guard File No.	Location	Map Code	Date	Vessel Name	Tug Assist	Type of Casualty				Total Damage ($1000)			Comments
						Ramming		Collision	Grounding	1.5-10	10-100	>100	
						Bridge	Pier, Other						
5943/135/74	Seattle	1	4/21/74	Oregon Mail	No		X			X			
5943/270/74	Seattle	2	8/17/74	Maria Rubicon	No		X				X		
5943/292/74	Seattle	3	8/29/74	Indian Mail	No		X			X			Crane hit mast
5943/19/75	Seattle	4	1/23/75	Oregon	No			X			X		
5943/65/75	Seattle	5	3/25/75	Skelerian	No		X				X		Gusty winds
5943/216/75	Seattle	6	10/25/75	Sealand Galloway	Yes		X			X			
5943/56/76	Seattle	7	2/11/76	Lloyd Bakke	Yes		X		X	X			
5943/88/76	Seattle	8	5/17/76	Aristeus	Yes		X				X		
5943/111/76	Seattle	9	5/23/76	Casaulina	Yes				X		X		
5943/149/76	Seattle	10	9/1/76	Pacific Carrier	Yes	X				X			
5943/190/76	Seattle	11	11/10/76	Hoegh Orris	No		X					X	
16732/18/77	Seattle	12	1/28/77	Viloet	Yes	X				X			
16732/23/77	Seattle	13	2/5/77	USNS Dutton	Yes			X			X		
16732/27/77	Seattle	14	2/18/77	Columbia	Yes		X				X		Erratic current

TABLE 6. DRY CARGO VESSEL (>18 ft. draft) ACCIDENTS (RAMMING, GROUNDING AND/OR COLLISION) IN THE PORTS OF SEATTLE, TACOMA AND EVERETT FOR THE PERIOD 1974-77. (Continued)

Coast Guard File No.	Location	Map Code	Date	Vessel Name	Tug Assist	Type of Casualty				Total Damage ($1000)			Comments
						Ramming		Collision	Grounding	1.5-10	10-100	>100	
						Bridge	Pier, Other						
16732/81/77	Seattle	15	4/2/77	Daverrazano	Yes			X			X		
5943/213/74	Tacoma	1	7/18/74	Star Fjellanger	Yes			X		X			
5943/224/75	Tacoma	2	10/21/75	Satya Kailash	Yes		X				X		
5943/236/75	Tacoma	3	11/22/75	Syuko Maru	Yes	X						X	
5943/247/75	Tacoma	4	12/6/75	Columbus Capricorn	No		X			X			
5943/39/76	Tacoma	5	2/16/76	Alaskan Mail	No		X				X		
5943/71/76	Tacoma	6	2/21/76	Columbus Canada	No		X			X			
5943/85/76	Tacoma	7	3/10/76	Eastern Hill	Yes			X	X		X		2 deaths
5943/162/76	Tacoma	8	9/25/76	Atlantic Rainbow	Yes				X	X			Heavy fog
5943/200/76	Tacoma	9	12/2/76	Dilkara	No	X						X	Patchy fog
16732/83/77	Tacoma	10	4/27/77	Oji Maru #1	Yes	X					X		Tug hit bridge
16732/105/77	Tacoma	11	6/17/77	Keiyo Maru	Yes	X				X			
16732/108/77	Tacoma	12	6/8/77	YoneKawa Maru	Yes			X		X			

TABLE 6. DRY CARGO VESSEL (>18 ft. draft) ACCIDENTS (RAMMING, GROUNDING AND/OR COLLISION) IN THE PORTS OF SEATTLE, TACOMA AND EVERETT FOR THE PERIOD 1974-77. (Continued)

Coast Guard File No.	Location	Map Code	Date	Vessel Name	Tug Assist	Type of Casualty				Total Damage ($1000)			Comments
						Ramming		Collision	Grounding	1.5-10	10-100	>100	
						Bridge	Pier, Other						
16732/157/77	Tacoma	13	8/23/77	Korean Mail	No		X			X			
5943/73/74	Everett	--	4/7/74	Shundwind	Yes		X						Cracked piling

Source: U.S. Coast Guard Files, 13th CG District, Seattle.

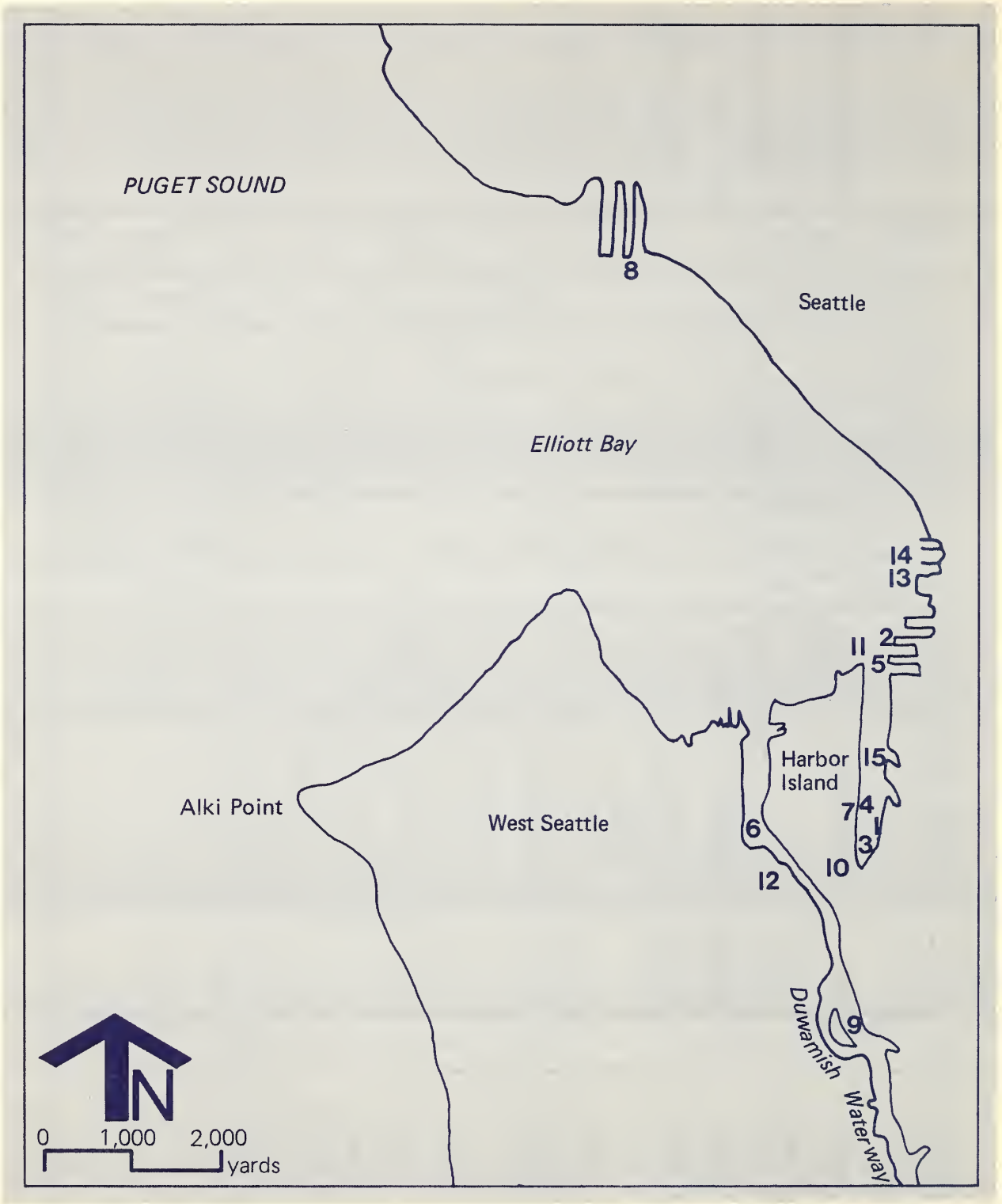


Figure 7

Location of Freighter Accidents in the Port of Seattle (1974-1977)

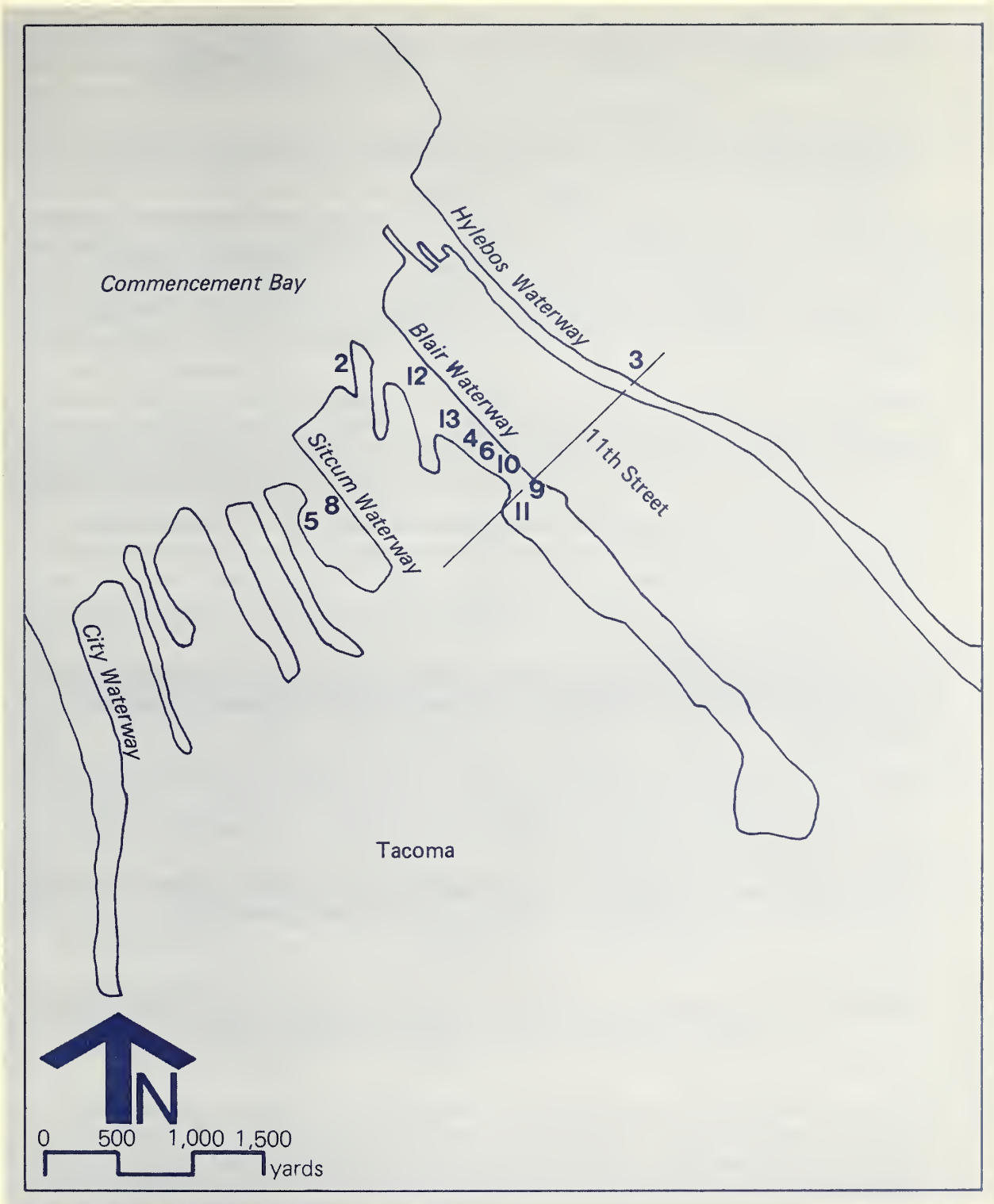


Figure 8

Location of Freighter Accidents in the Port of Tacoma (1974-1977)

TABLE 7. FREIGHTER (>18 FT. DRAFT) ACCIDENT RATES FOR THE PORTS OF SEATTLE, TACOMA AND EVERETT BASED ON 1974-77 DATA

Port	Number Accidents C/R/G[4] Minor	Major	Other[5]	Port[6] Calls	Accidents/1,000 Port Calls Minor	Major	All
Seattle[1]	6	9	6	4,086	1.5	2.2	5.1
Tacoma[2]	7	6	2	2,034	3.4	3.0	7.4
Everett[3]	1[7]	--	--	548	1.8	--	1.8

[1]Port of Seattle, as used here, includes Elliott Bay and the Duwamish Waterway; it does not include the LWSC because no freighter accidents were reported for it.

[2]Port of Tacoma, as used here, includes Commencement Bay and all waterways connecting thereto.

[3]Port of Everett, as used here, includes Port Gardner and piers capable of accepting ocean-going vessels; it does not include the Snohomish River.

[4]Number of accidents taken from Table 6. Minor accidents are defined as involving total damage (to vessel and to other property) of between $1,500 and $10,000. Major accidents are defined as involving total damage in excess of $10,000.

[5]Includes accidents such as fire and mechanical failure. These accidents are included in the "all" or total accident rate calculations.

[6]Port calls are defined for all dry cargo vessels greater than 18 foot draft, as:

$$\frac{\text{annual inbound calls} + \text{annual outbound calls}}{2}$$

Data for the years 1974-1976 were obtained from "Waterborne Commerce of the United States," published by the U.S. Army Corps of Engineers annually. The value for 1977 (the annual report has not been published at this time) was estimated by averaging the values for 1975 and 1976.

[7]The one accident in the Port of Everett is not technically "reportable" since total property damage was somewhat less than $1,500. It has been treated as "reportable", however, in lieu of disregarding it and arriving at an unrealistically low accident rate of zero for the Port of Everett.

Bay to Lake Washington). Hence, a separate analysis, described later, was required for the LWSC.

Although the Port of Tacoma consists of a series of waterways (in which most accidents occur) differentiation of accident rates in each waterway was not possible because the Corps of Engineers data on port calls is not so disaggregated. However, from Figure 8 it is evident that the Blair Waterway has had considerably more accidents in the period covered (1974-1977) than have other waterways. In the absence of data on port calls to the various waterways, no definitive accident rates can be determined for the candidate sites on the Hylebos Waterway. However, on a judgmental basis, it would appear that the Hylebos Waterway is likely to have a lower accident rate than that for the Port of Tacoma and, if such is true, the Blair Waterway would be expected to have a higher than average accident rate. However, in lieu of more detailed data, the accident rate for the Port of Tacoma has been applied to candidate sites on the Hylebos Waterway.

Accident rates were not obtainable for the candidate sites at Manchester and Muilteo which, at present, have no shipping activity. In lieu of historical data for these two sites, an accident rate, based on the historically-derived data developed for small port systems by OIW, was used.

The accident rates for the LWSC, including Lake Washington, were based on all commercial vessel accidents, rather than just freighters which represent little of the commercial traffic within the LWSC and none of the freighter accidents (cf. Tables 5 and 6). Hence, an indirect approach was used. Initially, the number of port calls (for all commercial vessels) to Lake Union and Lake Washington (data from the Waterborne Statistical Center of the Corps of Engineers) were determined:

Destination	Transits	Average Annual Port Calls	Percent
Puget Sound to Lake Union	9,211	4,606	80.5
Lake Union to Lake Washington	2,226	1,113	19.5
		5,719	100.0

Accidents were allocated to these two locations by multiplying the total accidents/year (from Table 5) by the percent of traffic to either Lake Union or Lake Washington. The results are shown below:

Place of Accident	Total Accidents/yr	Total Accidents in Lake Union	Lake Washington
Shilshole Bay	1.0	.8	.2
Channel	2.7	2.2	.5
Lake Union	.5	.5	--
Lake Washington	1.0	--	1.0
	5.2	3.5	1.7

Accident rate is then --

	Accidents	Port Calls	Accident rate/ 1,000 Port Calls
Lake Union	3.5	4,606	.8
Lake Washington	1.7	1,113	1.5

Following this reasoning, the accident rate for ships moving through the LWSC to Lake Washington is almost twice that of vessels moving only to Lake Union. Applying these accident rates to the overall accident rate for all vessels using the LWSC, we find 5.2 accidents/5,719 port calls = 0.9 accidents/1,000 port calls. The individual values calculated above deviate from the base value for the entire LWSC as follows:

$$\frac{\text{Lake Union}}{\text{LWSC base value}} = \frac{0.8}{0.9} = 0.9$$

$$\frac{\text{Lake Washington}}{\text{LWSC base value}} = \frac{1.5}{0.9} = 1.7$$

A base accident rate of 2.0 accidents per 1,000 port calls (a value somewhat greater than the average for small port systems, as identified by OIW, that is, 1.6 accidents per 1,000 port calls, was assumed to account for the constricted waters of the LWSC and their relatively high usage) was used to determine the apparent freighter accident rate of the two locations as follows:

Lake Union 2.0 x 0.9 = 1.8/1,000 port calls
Lake Washington 2.0 x 1.6 = 3.4/1,000 port calls

While the derivation of freighter accident rates for Lake Union and Lake Washington is by no means rigorous, and does assume the presence of freighter traffic, it does provide a comparison which indicates significant differences.*

*The elimination from the above analysis of fire-related accidents, which constitute a significant proportion of the accidents in this "port system" but which are generally considered to be independent of the port characteristics, had little effect on the results as they pertain to freighter accidents, namely:

Lake Union = 1.7 freighter accidents/1,000 port calls.
Lake Washington = 3.4 freighter accidents/1,000 port calls.

Recreational Vessels

Statistics on recreational boating accidents in the Puget Sound were obtained from the records of the Boating and Safety Division of the 13th Coast Guard District. Boating accidents by cause are shown in Figure 9 for Greater Puget Sound for a 3-year period (1975-1977).

Similar data for locations within the LWSC are shown in Figure 10. Although fire/explosion and grounding cause the greatest damage to boats, such accidents normally involve only the affected vessel and do not implicate other vessels. Collision, which involves two (or more) vessels, and capsizing, which may be caused by wake or "suction" action, are of interest in the present study. Collisions are the most common type of accident, normally involve another recreational craft, and result in most cases in limited ($<$\$1,000) damage. No collision accidents involving a small craft and an ocean-going vessel were found in either the LWSC or Greater Puget Sound. It is of interest, in Figure 10, that collisions are appreciably higher in Lake Washington than at other points in the waterway reflecting, probably, the higher usage and higher speeds on Lake Washington.

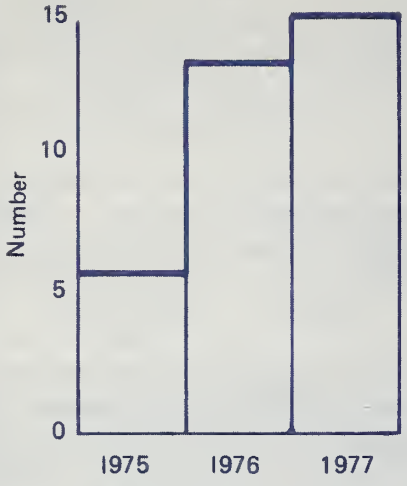
Capsizing does occur but no instances of capsizing due to wake from large commercial vessels were identified. The absence of any capsizing accidents within the LWSC may be attributable to the speed limit of 7 knots in effect in these waters (of course capsizing of canoes, kyaks and other small craft occurs regularly but permanent damage is unlikely). The number of capsizings in Lake Washington is higher relatively, but not attributable to commercial vessel operations.

Small boat accidents, as might be expected, show a marked seasonal variation (Fig. 11). The number of accidents rises in early spring, peaks in July, and drops in August and September. In contrast, a 1966 survey found heavy usage of the waters of Puget Sound from June through September with a third of all owners reporting usage throughout the year.* A similar usage pattern is likely in the LWSC. However, recreational boat usage in the LWSC and Lake Washington is concentrated in two major regimes: late afternoon and early evening during the week and from late morning to dusk on weekends (dependent, of course, on weather conditions).

Two other sources of information on accidents were contacted: City of Seattle Bridge Maintenance Division and the project engineer at the Corps of Engineers' Chittenden Locks. Damage to the locks does not appear to be a problem, aside from normal wear and tear and few accidents of consequence (primarily fire and/or explosion in small boats) have occurred in the locks.

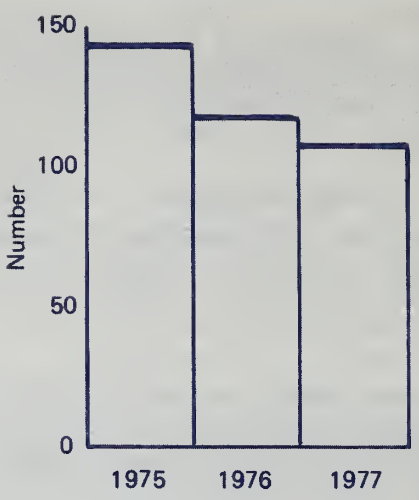
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*Pleasure Boating Study, Washington State Parks and Recreation Commission, November 1968.



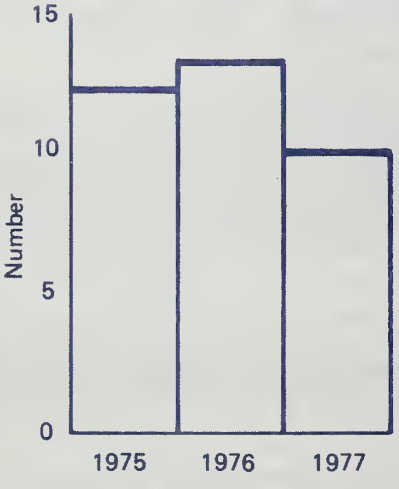
Fire/Explosion

Damage exceeded $1000.00
in 91% of all accidents



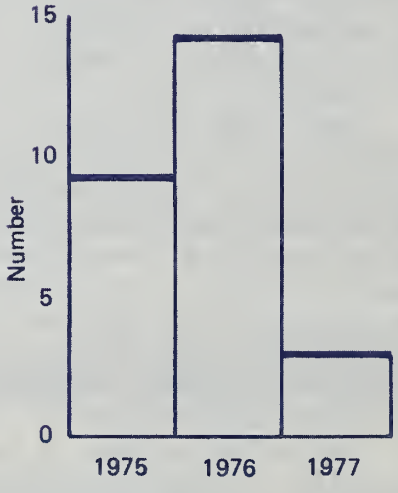
Collision

Damage exceeded $1000.00
in 25% of all accidents



Capsizing

Damage exceeded $1000.00
on 16% of all accedents i

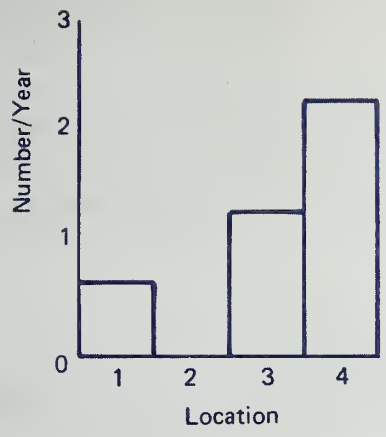


Grounding

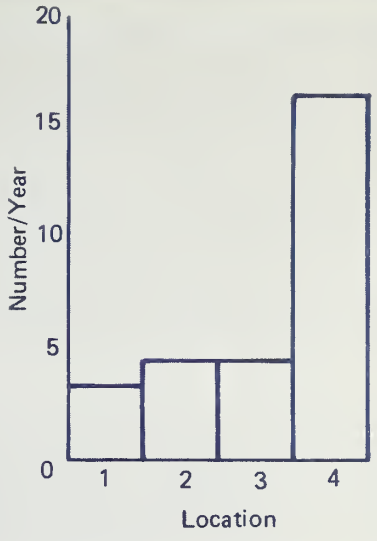
Damage exceeded $1000.00
in 57% of all accidents

Figure 9

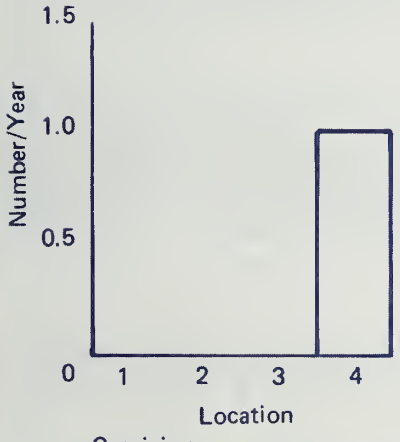
Boating Accidents by Type in Greater Puget Sound



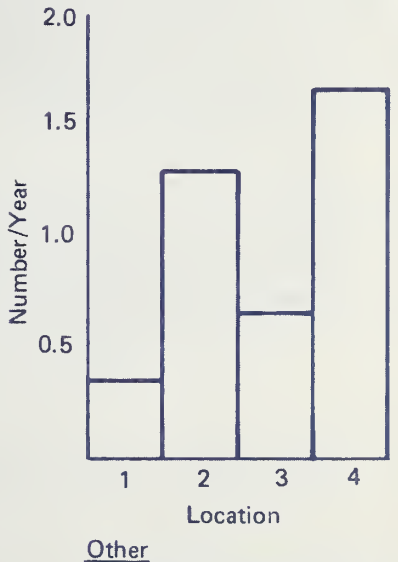
Fire/Explosion
Damage exceeded $1000.00 in 92% of all accidents



Collision
Damage exceeded $1000.00 in 21% of all accidents



Capsizing
Damage exceeded $1000.00 in 33% of all accidents

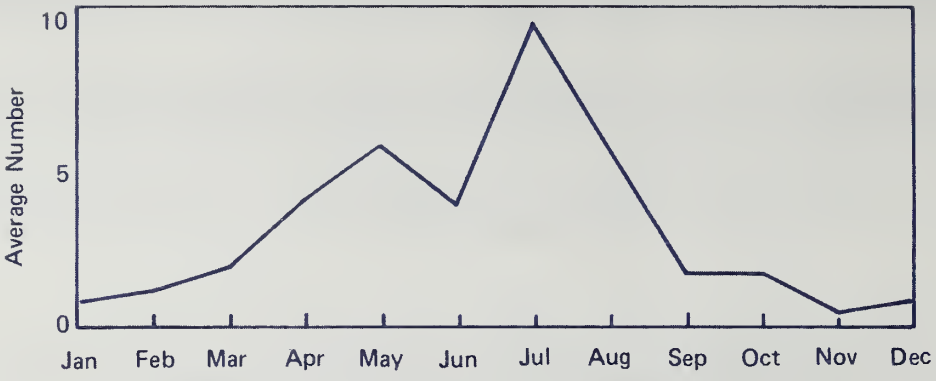


Other
Damage exceeded $1000.00 in 17% of all accidents

Location
1 – Shildole Bay
2 – Lake Washington Ship Canal
3 – Lake Union
4 – Lake Washington

Figure 10

Type and Location of Boating Accidents in the Lake Washington Water Way



Source: 13th Coast Guard District and URS.

Figure 11

Small Boat Accidents in and about Lake Washington Ship Canal

The Seattle City bridges in the LWSC are frequently "brushed" by the antennae and/or masts of both recreational boats and commercial vessels often resulting in damage to the vessels but little or none to the bridge. According to representatives of the Seattle Bridge Maintenance Department, the Montlake Bridge has the fewest such incidents (one was identified in the period from 1971-1977) while the Fremont Bridge, with lower vertical clearance has the most (17 in the same period). No instances were recalled in which a ship struck a bridge with sufficient impact to cause damage which necessitated its closure for more than inspection purposes.

NOAA Vessels

Over the many years of operation within the LWSC, NOAA vessels have reported several incidents where NOAA vessels have caused property damage either to themselves or to property owned by others. A brief description of such incidents since 1959 and their severity is included in Appendix 6. Only one reportable accident* (the Surveyor hitting the old Great-Northern railroad bridge in 1960 causing $5,000 damage to a pier but none to the ship), occurred in this reporting period. (It should be noted this one accident falls in the "non-major" category. According to the OIW study, previously referenced, only 27% of all reportable accidents in Greater Puget Sound are "non-major"). While a statistically valid accident rate cannot be developed from one event, an "apparent" accident rate can be calculated, namely:

$$\frac{1 \text{ accident}}{40 \text{ port calls per year} \times 19 \text{ years}} = 1.3 \text{ accidents/1,000 port calls}$$

The NOAA fleet has an "apparent" accident rate which is less than that experienced by freighters in small port systems, that is, 1.6 accidents/1,000 port calls (OIW, Sept. 1977, based on the "best fit" curve for 9 small port systems). For comparative purposes, based on both the "apparent" accident rate and the special handling characteristics of NOAA vessels (discussed in Section III), an accident rate of 1.1/1,000 port calls (2/3 that of commercial vessels) has been assigned vessels in the NOAA fleet.

NOAA vessels have had, as do most commercial vessels, on occasion, engine failure, steering failure, and engine room fire.** None of these incidents, which can be generally termed as breakdowns in the water, resulted in accidents primarily because most occurred in open waters where the vessel could drift safely. By comparison, the Coast Guard ship

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*A reportable accident, as used here, is one in which property damage exceeded $1,500 damage resulting from collision, ramming or grounding.

**Mechanical failure, in NOAA's experience, is most likely to occur after a vessel has undergone some type of repair or renovation.

accident rate for the Greater Puget Sound reports about 20 requests a year for Coast Guard assistance due to breakdown. Most of those incidents, as with NOAA vessels, occurred in open waters with no serious accidents resulting.

If any larger vessel were to breakdown while transiting portions of the LWSC where the channel width is narrow, collision or ramming might result. However, historically such accidents have not been reported. For example, returning to the Coast Guard data for Puget Sound, fourteen accidents with damage were attributed, in a 4-year period, to mechanical failure; most were related to tow ropes breaking, bilge pump failure or miscellaneous causes. Only two cases relate to engine failure, one with minor damage and the other with major damage (the engine of a ferry failed as it approached its dock). Thus, while mechanical breakdown does occur, it appears to rarely result in serious accident.

NOAA vessels have never experienced a collision or ramming accidents and, consequently, have never experienced a massive fuel oil outflow which sometimes results from such accidents. Fueling, which typically causes the most and largest of the dockside spills, is not conducted in the LWSC with minor exceptions.* NOAA has reported a total of eight dockside spills, primarily from internal fuel transfer operations between 1973 and 1977 at the Pacific Marine Center on Lake Union, resulting in an average oil loss of 40 gallons per event. Since the ships are normally "boomed," little or none of this oil entered into the waters of Lake Union. PMC has operating procedures, which will be discussed in more detail later, for the containment and cleanup of small or large spills which it might cause.

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*Class V vessels occasionally fuel at a commercial pier in Salmon Bay.

III. IDENTIFICATION OF RISKS

NOAA vessels are just one of the many users of the waters of Greater Puget Sound and, with other users of these waters, share the same navigational risks. These risks are not seen as unusual, reflected in the accident rate for the Greater Puget Sound which is average for a large port system. Puget Sound has its share of foul weather but, on the other hand, commercial traffic is rarely heavy, the waters are deep, currents are generally weak, and the shelter provided by adjacent lands helps minimize wind effects. Further, the vessel traffic system which is operational within Puget Sound provides information to the skipper in these waters. (The VTS, through direct communication with each ship -- including NOAA vessels -- as well as shore-based radar, tracks each vessel, at all times, within the waters of Greater Puget Sound). Further, all NOAA vessels are equipped with onboard radar and sonar equipment (normally with backup units), which allows the skipper to continuously monitor potential navigational risks as he moves forward. Additional details may be found in Appendix 4.

However, there are navigational risks which are of concern. These risks have been identified for the various candidate sites and will be discussed below. Again it is stressed that because of the particular interest in those sites within the Lake Washington Ship Canal that it will receive more attention than other sites which have direct access to Puget Sound (also, more information is available on the transit through the LWSC because of previous study related to the Environmental Impact Statement).

A TRANSIT THROUGH PUGET SOUND

All candidate sites would require transit of the waters of Puget Sound. To determine if the accident potential varies due to transit differences a case study was conducted comparing potential risk exposure for NOAA vessels proceeding to (1) the LWSC, and (2) the extreme terminus at Tacoma. A route which NOAA vessels would take in each of these transits is shown in Figure 12. In either transit, the vessel would utilize the Puget Sound Vessel Transit Service (VTS) and would follow the designated traffic lanes. Each one-way traffic lane is 1,000 yards wide with a 500 yard separation zone. The traffic lanes include, where necessary, precautionary areas to accommodate traffic from nearby ports moving into or out of the traffic lanes. The first precautionary area is located at Point No Point to accommodate traffic from Everett and elsewhere. From this point, LWSC-bound NOAA vessels would proceed in the southbound

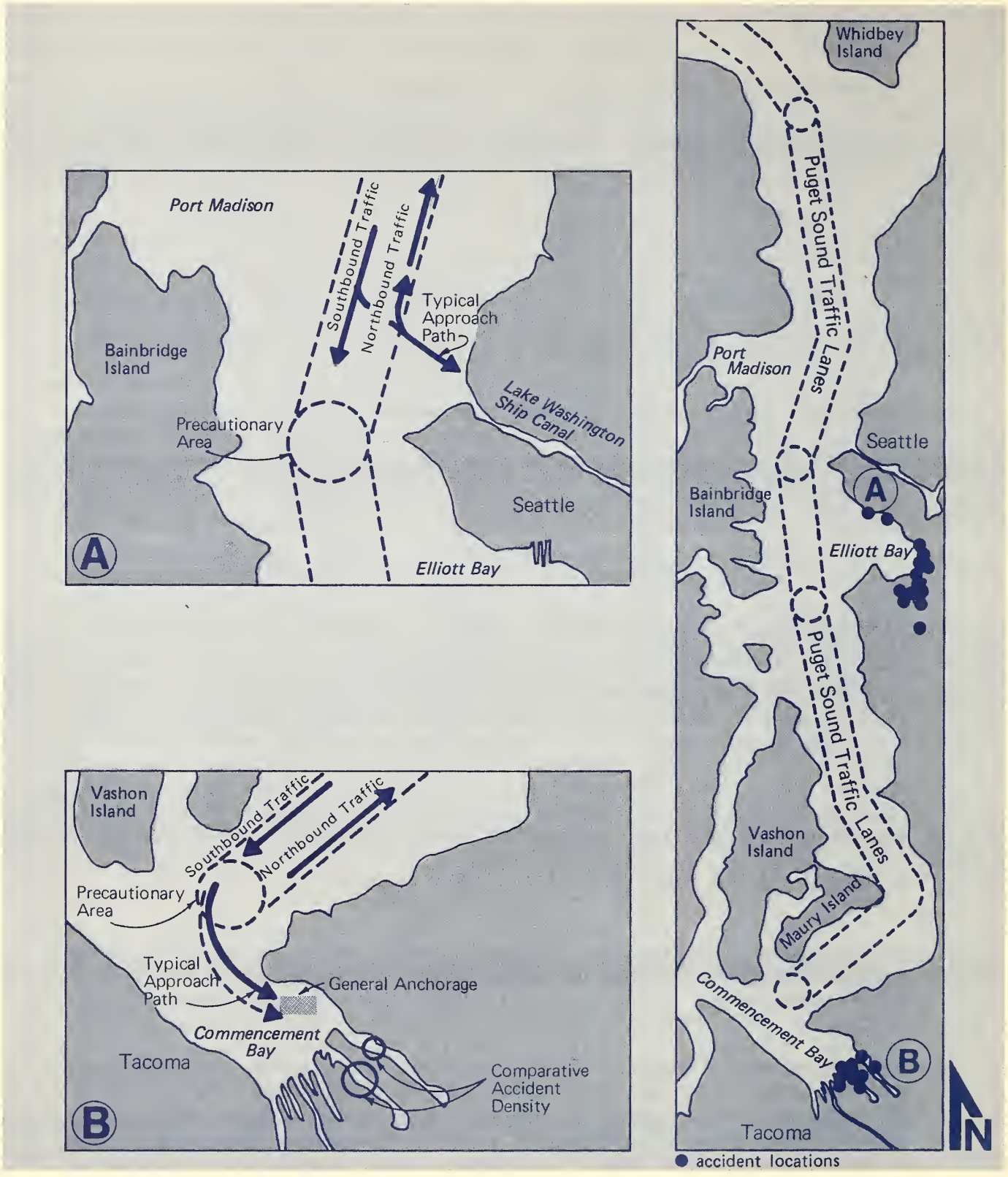


Figure 12

Vessel Transit Routes to Lake Washington Ship Canal and Tacoma

traffic lane to a buoy abeam of Shilshole Bay where they would turn sharply to the left (to minimize time in the northbound traffic lane) to reach the waters of Shilshole Bay. At this juncture, the vessel would notify the VTS of its departure from the system. Because of the low traffic density at this point, there is no designated precautionary area.

Tacoma-bound NOAA vessels would continue in the southbound traffic lane, passing through precautionary areas, just west of West Point and Alki Point, which accommodate Seattle traffic. There is also a great deal of cross traffic, primarily ferries, in this area. The vessel would then continue in the southbound traffic lane down East Passage to the terminus of the VTS in a precautionary area outside and just to the north of Commencement Bay. At this point, the vessel would sign out of the VTS, indicating its destination. The NOAA vessel would then proceed past a buoy just off Brown's Point entering the deep, open waters of Commencement Bay, bypassing an anchorage area prior to entering the Hylebos Waterway.

No data were found which could be used to quantify the risk during transit (say in the form of 0.000XX accidents per transit mile). However, the probability of accidents increases with increased exposure (that is, total distance traveled). On this premise then, the risk of accident while in transit to Tacoma is greater than while in transit to the LWSC. Although the incremental increase in the risk is difficult to measure, it appears to be inconsequential in relation to the risks associated with the much longer transit through upper Puget Sound or with increased accident risks associated with the movement in the restricted waterways of the LWSC or Hylebos Waterway.

DIRECT ACCESS

The candidate site at the Port of Everett is easily reached once the vessel passes Point No Point by movement up through Possession Sound into the port which is sheltered to some considerable degree from the higher than average winds in that area. The vessel must cross the route of the Mukilteo-Whidbey Ferry but no particular problems are foreseen. Although maintenance dredging is required periodically in the Port of Everett, grounding has not been found to be a problem by ocean-going vessels. Commercial traffic density is relatively low and recreational boating is common but does not appear to present any special navigational risks to NOAA vessels.

The candidate site at Mukilteo presents no special features and does not cross any ferry routes.* However the proposed site on Possession Sound is on open waters with no land features to break winds to the north or to the south. These long fetches have been reported to cause waves of up to

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*Aside from Canada- and Alaska-bound ferries in the main traffic lanes in Puget Sound which run in summer months only.

6 feet in height in winds of 40 knots. NOAA personnel indicate that a breakwater to the north and to the south of the proposed pier location would be required to permit safe operations. (In heavy seas the breakwater in itself could present a hazard to incoming NOAA vessels.) The proposed site would also require considerable dredging because of the shallow depths near shore but, once dredged, vessel grounding should be unlikely within the maintained channel. An onshore safety concern, unique to this site, is the requirement to cross the two tracks of the Burlington-Northern main line which lie at the base of the bluff, separating shore facilities from the proposed pier site. While gates could regulate surface traffic, the conflict between moving supplies to the pier in an orderly manner would better be resolved by the installation of an overpass.

The Manchester site is reached by normal traffic lanes to a point opposite the City of Seattle and then following essentially the path of the Seattle-Bremerton Ferry to the beginning of Rich Passage. This transit into Clam Bay is through relatively open waters which, in addition to the ferry which runs on a 1-hour schedule, may include occasional Navy vessels and the usual recreational traffic. Caution would have to be exercised in leaving the piers to prevent possible conflict with eastbound traffic through Rich Passage. Ebbtide currents through Rich Passage can become fairly high (well over 1 knot) and, partly for this reason, a partial breakwater at this site may be required. The Manchester site, located in Clam Bay, is on a shallow shelf, necessitating either extensive dredging, a very long pier, or a combination of both. Although the rate of siltation is not well known, maintenance dredging would certainly be required, and the dredged channel would have to be well marked and closely followed. Recreational boating is relatively low in this area (partly because of the relatively low residential density as well as the lack of large marinas) so that no particular problems are foreseen. Winds are lower than average at this site but fog may be slightly more frequent.

The two Tacoma sites are reached by continuing down Puget Sound through East Passage into Commencement Bay. The passage up to this point is well marked and no particular difficulties are expected. The North Tacoma site on the Hylebos Waterway is reached by a dredged channel (190 feet wide and 30 feet project depth). With proper pier design, NOAA vessels could dock without impinging on the existing channel. Commercial activity within the Hylebos Waterway is relatively heavy but simultaneous movement of two large vessels is infrequent. A boat sales outlet near the proposed site would generate little recreational traffic; rather a marina further up the waterway is the source of most recreational traffic.

The South Tacoma site requires passing through the East 11th Street Bridge which has a horizontal clearance of 144 feet (the vertical clearance of the unopened bridge is 21 feet). At this point the channel narrows to 160 feet. Channel depth in the Hylebos Waterways varies between 26.0 and

28.3 feet. The proposed South Tacoma site would likely require that NOAA vessels at times maneuver into the main channel while entering or leaving the dock. However, the use of the turning basin at the upper end of the Hylebos Waterway might alleviate this particular possibility. This site, like the North Tacoma site, is well sheltered from the lower than average winds experienced in the Tacoma area, but, is likewise subject to a higher than average accident rate. Recreational traffic, although present, does not seem unusually high. The East 11th Street Bridge, which because of its age and construction has experienced over the years operational difficulties, is unlikely to create any major risks or problems. If bridge failure occurs, the bridge is left open to allow water traffic to proceed until such time as repairs are completed. Visibility in both directions on approaching the bridge is good, but nonetheless, it would be advisable for NOAA vessels to maintain radio contact with the tender on approaching the bridge.

In summary, all candidate sites with direct access to Puget Sound have a common asset: virtually unrestricted availability at all times.

THE LWSC AND LAKE WASHINGTON

For simplicity, the identification of risks in this waterway will proceed from Puget Sound and Shilshole Bay through the LWSC to the terminus at Kenmore. These identified risks will, in a later section, be quantified so that any portion of this route which is used by any particular candidate site condition can be evaluated in terms of risk. Figure 13 is a map showing various features pertaining to navigational risks along the LWSC. A similar map is not included for Lake Washington because of the relatively simple transit in those waters.

Shilshole Bay entrance range affords a wide, deep channel which provides sufficient maneuvering room to minimize problems and/or accidents in these waters despite the presence of a very large marina for small boats just at the entrance (north side) and the "stacking," particularly of recreational boats, at the end of weekends, awaiting movement through the Chittenden Locks. However, the approach to the locks themselves can, and sometimes does, present difficulties. Vessels must first pass through the Burlington-Northern railroad bridge just prior to entering the locks. NOAA vessels attempt to coordinate these two actions such that the bridge is open and the green light for entrance into the locks is visible since standing by in these waters can be difficult, especially when the locks have just opened releasing water and creating transient currents. (Currents can also be a problem in this area when spring runoff necessitates the release of water from Lake Washington.) Some difficulty has been experienced by NOAA vessels in this transit and in two instances vessels have damaged topside equipment by brushing against the bridge. In one case the bridge was not open sufficiently to allow

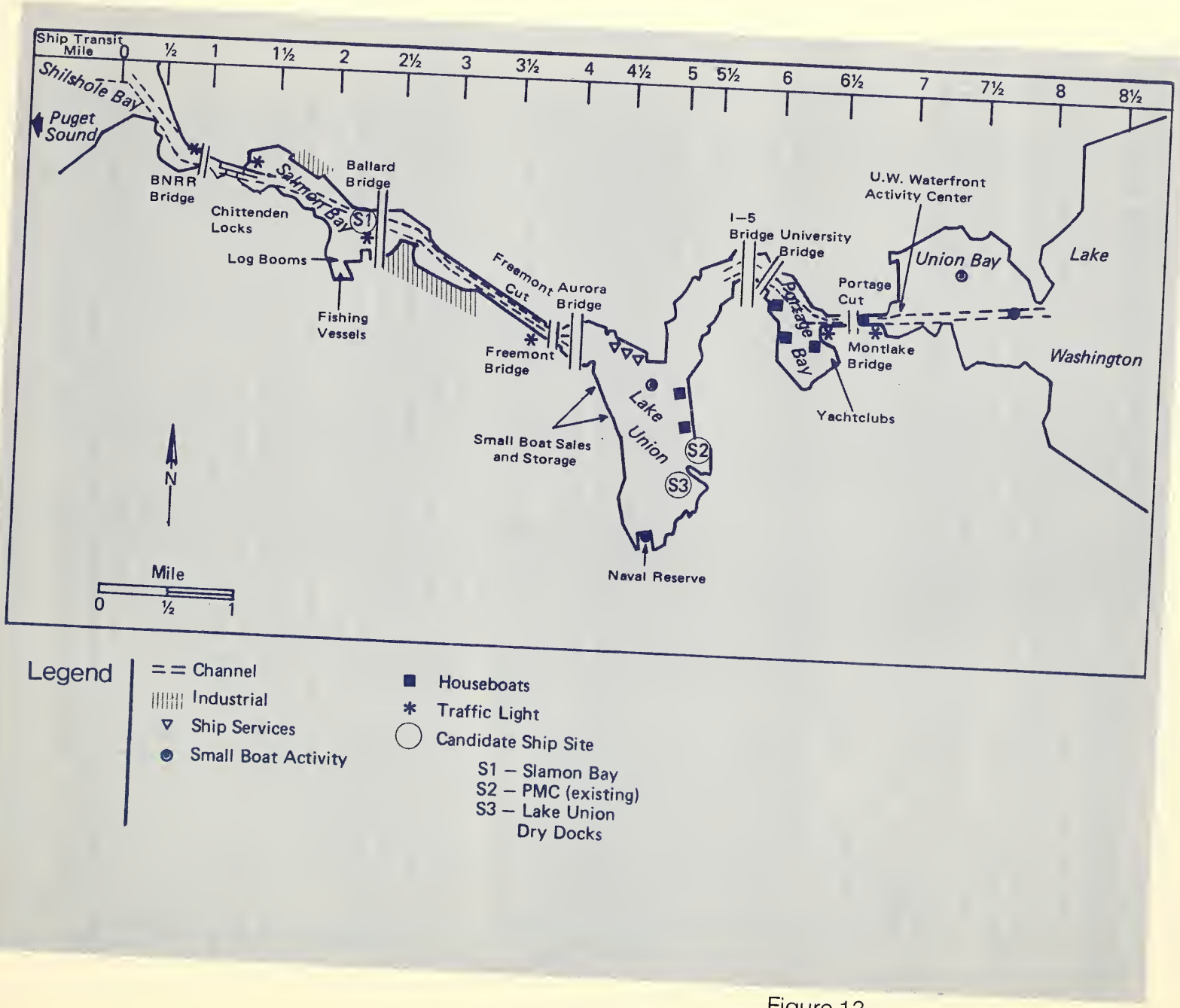


Figure 13

Features of the Lake Washington Ship Canal

the vessel to pass (an apparent misjudgment on the part of the bridge tender) and the other resulted from a communications problem. There is always some concern among NOAA skippers that the bridge will not open as requested to allow direct movement into the locks. This juxtaposition of bridge and locks has been identified as a potential problem area.

Although by regulation, government vessels can take precedence over other vessels in entering the Chittenden locks, NOAA vessels do not exercise this perogative. Moreover, NOAA vessels normally try to enter Shilshole Bay and the locks at off-peak hours, generally prior to mid-afternoon, so that traffic is unlikely to be heavy. Since NOAA vessels often pass through the locks at the same time as other vessels, NOAA vessels may be affected by their presence. A slightly heightened potential for fire and/or explosion in pleasure craft which could affect other vessels in the locks is a notable example. Likewise, occasional brushing of vessels within the locks can occur but rarely has serious consequences.

A possible serious accident could occur if a large ship coming into the locks were to proceed too rapidly and ram the gate at the east end of the locks. Conceivably such a movement could spring these gates open, jamming them and allowing a deluge from the higher level waters of Lake Washington. An incident of this nature has never occurred but, to preclude such a possibility, normal operations of the locks requires that, immediately upon entrance into the locks from Shilshole Bay, the westerly gate be closed. The problem does not exist outward bound because of the configuration of the gates and their inherent strength. The locks themselves are adequate in both depth and breadth for NOAA vessels and no constraints have been experienced. A saltwater barrier normally extends into the locks to preclude saltwater intrusion into Lake Washington. Its presence is signaled by an appropriate light and it would be lowered prior to the passage of larger NOAA vessels.

Larger NOAA vessels (Classes I, II, and III) are, and would continue to be, unable to use the LWSC during certain periods. The large Chittenden Lock is closed for maintenance for about two weeks each year. However, this closure is scheduled well in advance so operations to date have not been affected. Emergency repairs on the locks have not caused any reported problems. The LWSC is also officially devoted to recreational vessels on "Opening Day" and one or two other regatta type events which occur on weekends. Unofficially, the LWSC is avoided by commercial traffic on summer weekends because of the heavy recreational traffic. The worst "traffic jams" are reported on Sundays (or Mondays on holiday weekends) when recreational vessels wait to pass from Shilshole Bay into the LWSC.

Leaving the locks, vessels proceed into Salmon Bay which is sufficently large and deep to provide maneuvering space. There is a considerable amount of industrial and pier activity in Salmon Bay and the southern end includes the major portion of the fishing fleet within LWSC and a place for log booming. The first split site alternative is located on the north side of Salmon Bay just west of the Ballard Bridge. Salmon Bay is judged to have sufficient maneuvering room for present and future commercial activity.

Leaving Salmon Bay, vessels must pass the Ballard Bridge, which is the first of a series of bridges operated by the City of Seattle. Bridge tenders operating alone, are selected for their perceptiveness and ability to make quick decisions. In some instances they operate traffic lights (shown in Fig. 13) which control vessel traffic of over 300 tons through the LWSC. Bridge tenders must be capable of evaluating the surface flow over the bridges versus the requirement to open the bridge for an oncoming vessel. Oncoming vessels, using appropriate whistle signals, signal their request to the bridge tender for a bridge opening, normally at a distance of about 350 to 400 yards. The bridge tender responds if he intends to open the bridge. If not, the oncoming vessel must come to a full stop in the water and hold in place until the bridge tender indicates an opening is forthcoming. However, on rare occasions, the bridge tender may not respond promptly and the skipper of an oncoming vessel must then make an on-the-spot evaluation as to whether to slow down preparatory to stopping or to assume that the bridge will open prior to his arrival. In some very rare circumstances, bridge mechanisms can fail and the bridge may not open or only open partially. However, no serious accidents have occurred as a result of such failure.

This concern over the possible failure of bridges to open in a timely manner (and the resultant requirement to stop quickly) has led the skippers of larger NOAA vessels to request PMC to dispatch personnel to the individual bridge tenders to alert them of the forthcoming transit of a NOAA vessel. In this manner, radio communication along the LWSC can be maintained between the PMC representative on the bridges and the vessel to verify requests for an opening.

As an improvement in its service, and to reduce the possibility of ramming of bridges, the City of Seattle is presently installing radio equipment which will allow direct communication from the ship bridge to the bridge tender at all times. Presently only the Fremont Bridge has this radio equipment installed but all bridges operated by the City of Seattle will be so equipped within the near future. The City is also planning nighttime bridge tender staff reductions which will require ratification of bridge openings, after 12 midnight. This change should have no impact on NOAA operations.

Despite the various precautions undertaken by NOAA and the upgrading of the communications between ships and bridges, some risk is associated with passing through bridges, especially where the channel provides little or no maneuvering room in case the bridge does not open. In the unlikely event of a ship hitting a bridge, damage to the superstructure of the ship and to the bridge structure itself could result. On the other hand, piers and bridges along the LWSC are properly protected (usually by bulkheads) and the possibility ". . .of crippling damage caused by a colliding vessel, NOAA or otherwise, is almost non-existent." (Nickum and Spaulding, Sept. 1, 1977, pp. 13-14).

Shortly after leaving Salmon Bay, NOAA vessels enter the Fremont Cut with a project depth of 30 feet and a channel width of about 100 feet. Traffic through this constricted cut is regulated by two sets of traffic lights, one just west of the Ballard Bridge and the other just west of the Fremont Bridge. These lights are, in turn, regulated by the bridge tenders who have clear views, from their respective bridges, to determine if traffic control is required. All vessels over 300 tons are so regulated. Smaller vessels are not controlled by the lights and are free to move through the cut. Normally no problems are encountered with recreational vessels since there is additional water on either side of the dredged channel into which they can maneuver if necessary.* Generally the traffic system operates effectively although on occasion traffic lights are ignored and vessels of greater than 300 tons have met in the cut. Infrequently, barges, and sometimes ships, touch bottom (i.e., temporarily ground) in the cut, particularly near the east end of the Fremont Bridge. Generally the consequences are minor.

The Fremont Bridge, which is the lowest of the series of bridges (vertical clearance of 31 feet at the center as contrasted to 44 to 46 feet at the center of the other bridges), requires many more openings than these higher bridges. It also experiences a much higher accident rate, as noted previously. Because of the lower clearance on this bridge, ramming of it in an unopened position by any large vessel might incur considerable damage to both ship and bridge. Such, however, has never occurred.

After passing through the Fremont bridge vessels pass under the fixed Aurora Bridge to enter Lake Union. Lake Union is heavily utilized for industrial, commercial and recreational purposes. The eastern shore is the present location of the Pacific Marine Center (candidate split site No. 2) and candidate split site No. 3. Lake Union, and to a lesser degree Salmon Bay, include the various ship fitting and repair services which are presently utilized by NOAA vessels and would continue to serve any candidate sites within the LWSC locale. The western shore of Lake

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*In most portions of the Fremont Cut the width at the surface is about 270 feet, providing maneuvering room for small craft with shallow drafts.

Union includes some marinas for small boats and a number of firms engaged in boat sales and services. The eastern shore of Lake Union, just north of the PMC, includes moorings for a number of houseboats which are susceptible to flooding from wakes. However, no complaints about wake disturbance from NOAA vessels to houseboats were found. The northern portion of Lake Union is also occasionally used for regattas and seaplanes routinely land on its waters. Surprisingly few problems related to traffic density have been identified despite the heavy usage of the waters of Lake Union.

From Lake Union, vessels proceed northeasterly where they must make a 113 degree turn under the Interstate 5 fixed bridge and, immediately, must be prepared to request a bridge opening for the University Bridge. Because of the lack of visibility at this turn, concern has been expressed as to the reliability of bridge opening for eastbound vessels. For example, if a NOAA vessel were to complete the 113 degree turn and find that the bridge was not open, the vessel would have to attempt to come to a rapid stop by reversing engines. In such stop, it is conceivable that the vessel might overreact and damage shoreside facilities. However, the implementation of radio contact capabilities on this bridge will alleviate this particular risk considerably. Nonetheless, the passage under University Bridge remains a moderate risk concern.*

The vessel then proceeds through Portage Bay Reach where the channel is adequate. The southern portion of Portage Bay itself contains a number of houseboats and marinas which generate considerable recreational boating activity.

The vessel must then make a slight turn to line up with the Portage (Montlake) Cut at the end of Portage Bay Reach. Maneuvering room at this point is somewhat limited because of the presence of a charted shoal, making it difficult for larger ships to be accurately aligned prior to entering the cut (channel width is about 100 feet and project depth is 30 feet). The Portage Cut, unlike the Fremont Cut, is steeped bank allowing little maneuvering room outside of the channel itself for small vessels.** Larger vessel traffic (greater than 300 tons) is controlled by the bridge tender on the Montlake Bridge, which is in the middle of the Portage Cut. Some concern has been expressed about the visibility of the

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*A detailed account of the navigational concerns experienced by the Oceanographer, a Class I NOAA vessel, in an "experimental" transit from Lake Union to Lake Washington in 1975, is available, and is reflected in observations by Captain Barbee. However, it must be recognized that the problems noted by Barbee are his own perceptions. Other NOAA Class I vessels have made this transit previously, but observations, similar to those of Barbee, were not recorded since that was not the intent of such transits.

**Width at the surface is 170 feet.

single traffic lights at either end of the cut (they are "commercial" size) which, although not controlling small boats, could at least alert them of a potential traffic problem.

The vessel, once aligned with the Portage Cut, then proceeds, signaling the Montlake Bridge for an opening. Visibility from the Montlake Bridge is excellent in both directions, possibly accounting for the very low accident rate at this bridge. An expressed concern, however, is that in the event that the Montlake Bridge should fail to open or if some other unusual event occurred, such as a recreational vessel cutting in front of the oncoming NOAA vessel or a tug running the traffic light, that the NOAA vessel would have to make an effort to stop or maneuver to avoid an accident. The configuration of the Portage Cut allows little safety margin for larger NOAA vessels, as shown in Figure 14. NOAA vessel striking the stepped sides of this cut might suffer structural damage. However, the extent and seriousness of such damage as might occur is speculative.

A minor risk noted in the Portage Cut is a METRO storm drain overflow, which operates only in very heavy rains. It discharges into the south bank of the Portage Cut near the Montlake Bridge. On one occasion, a yacht reported navigational problems as a result of this discharge. A new regulator is presently being installed which will eliminate storm drain overflow into the cut. In any event, this discharge does not pose a risk to NOAA vessels.

A very real concern, however, is the presence of heavy recreational usage of the waters of both the Portage Cut and of Union Bay Reach just beyond it. The University of Washington Yacht Club and Waterfront Activity Center are both located at the east end of the Portage Cut and generate very high recreational usage of the waters of Union Bay and of the Portage Cut itself. However, small rental craft (canoes, kayaks) are not permitted inside the Portage Cut. Some swimmers are also found in these same waters. NOAA skippers, particularly on larger vessels, could have difficulty in spotting such small objects as swimmers or boats (including kayaks, canoes, etc.). This disadvantage is overcome by the use of "spotters" on the bridge "wing" and on the bow. These spotters can alert the skipper to upcoming craft as well as to proximity of the vessel to the channel walls. Still the concern remains that a NOAA vessel may have to attempt, in the very constricted waters of the Portage Cut, to stop or otherwise maneuver to avoid careless or reckless recreational craft or persons.* This, indeed, is a real concern and alone accounts for the higher risk value assigned to the Portage Cut. However, it must be noted that in the off season or in off-peak hours, the Portage Cut may be little utilized for recreational purposes and, at those times, the risk is lower.

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*A consistent concern expressed was the lack of training and licensing of recreational boat users in the State of Washington. Numerous accounts are given of "less-than-cautious" actions on the part of some small boat operators, seemingly without regard to navigational risks.

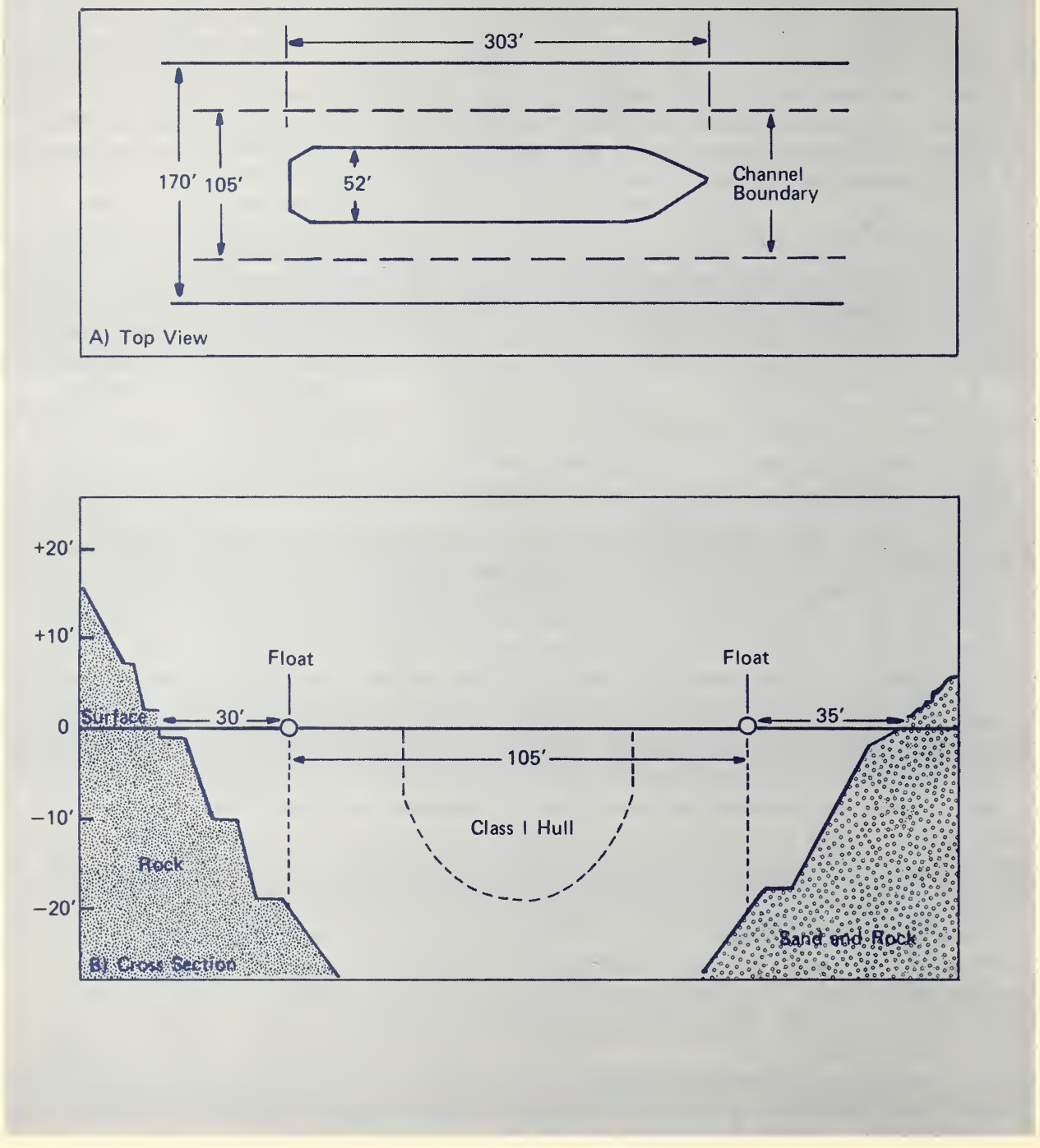


Figure 14

Large Class I NOAA Vessel Superimposed on the Portage Cut

Vessels then proceed into Union Bay Reach which has a considerably wider channel, past Webster Point where they then turn northward into Lake Washington for their ultimate destination of either Sand Point (a candidate consolidated site) or Kenmore, a candidate consolidated site). The waters of Union Bay are heavily used for recreational purposes and Union Bay Reach itself also serves, presently, as a passing area for commercial vessels moving in the opposite direction. NOAA skippers have expressed concern about meeting commercial vessels in Union Bay Reach but representatives of the Corps of Engineers do not perceive this particular concern, feeling that there is sufficient maneuvering room for any passages required. In this Reach too, recreational vessels, although sometimes numerous, have maneuvering room to both the north and the south of the channel. However, it is generally agreed that the navigational markers within the Reach tend to drift and probably should be augmented with fixed markers.

Lake Washington is used extensively for both recreational and commercial activities. Because of the open expanses and deep waters, maneuverability in these waters is greater and the risk of collision between NOAA vessels and other vessels decreases. The boating accident rate in Lake Washington (see Fig. 10) which is relatively high appears to correlate with the heavy recreational traffic.

Although dredging would be required at the proposed pier configuration at Sand Point, no particular navigational risks are seen at this site. However, berthing the ships at the proposed site at Kenmore may present some special problems. The presence of a small boat sales marina, seaplane base, a cement plant with attendant barge traffic and recreational usage of the waters adjacent to this site indicate that NOAA vessels might have a somewhat higher risk of collision, especially with recreational craft, in this particular area of Lake Washington. Also, since the Sammamish River does flow into Lake Washington at this point, siltation can be anticipated, and conceivably could lead in years of heavy runoff, to the increased possibility of grounding of NOAA vessels approaching their mooring.

In summary, the Lake Washington Ship Canal presents an interesting dichotomy. That portion from Shilshole Bay to Lake Union is relatively heavily used by commercial traffic including NOAA ships. This western portion includes a set of locks, a cut, and several bridge crossings. Yet, it is perceived as a routine transit which, with proper indoctrination, presents no unusual hazards to the careful skipper. However, the transit from Lake Union to Lake Washington, which includes similar types of waterways and impediments, is perceived by some as a much riskier transit than from Shilshole Bay to Lake Union, but by others as virtually identical in terms of risk. This wide divergency of viewpoint indeed presents a puzzle.

Various testimony, primarily from pilots and barge operators on these waters, indicates that the transit from Lake Union to Lake Washington is essentially routine and of no special concern. Additional substance can be

given to this position by the recorded movement of large ships (in most cases, larger than the largest NOAA vessels) through the Lake Union to Lake Washington transit from before World War II to as recently as 1973. Occasionally a large ship still makes this transit and, as shown in Figure 3, considerable commercial traffic, primarily log rafts and tows, also regularly traverse these waters.

On the other hand, the risks identified in the discussion above, are of great concern to the proposed users of this transit, namely, the National Ocean Survey which maintains and operates all NOAA vessels. These proposed users of the waters from Lake Union to Lake Washington are concerned that, despite the earlier use by large commercial vessels, the increased use of these waters for recreational purposes has altered the historical perspective. The viewpoint of these intended users of these waters is indeed most important to consider. It is insufficient to note that commercial vessels, albeit primarily log rafts and tows (that is, tugs and barges), use these waters routinely and that these commercial activities likely impinge more upon the existing recreational usage then would NOAA transits.* Recognizing this difference of opinion regarding the degree of risk which is entailed in transiting from Lake Union to Lake Washington, a more quantitative assessment of the risks was conducted. It is presented in a later section.

NOAA VESSELS

The NOAA fleet of vessels stationed at the Pacific Marine Center presently numbers 10 with possible expansion over the next few years of up to 12. The vessels vary in size and purpose and each have specific project assignments which, in turn, lead to rather unique characteristics for the various vessels. For convenience these vessels are divided into five classes: the major characteristics of each ship are shown in Table 8. All vessels are ocean-going and typically may spend months away from port. For comparative purposes, the Class I vessels are similar in dimensions to a medium-sized freighter; the Class II to a small freighter; the Class III vessels to a small ferry; and the Class V vessels to a large fishing boat. There, the comparison stops. Because of the specialized requirements of these vessels, they are generally equipped with additional propulsion, steering, and navigational aids not normally found on commercial vessels. Table 8 provides the ratings of these operational characteristics with a comparison made between the classes of vessels. Additional technical information can be found on ship characteristics in the Naval Architect's Assessment in Appendix 4.

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*NOAA vessels routinely operate at about 4 knots in these waters which, according to several sources, is somewhat faster than the speed of a log boom but slower than a loaded tow. On one hand, the maneuverability of NOAA vessels is much greater than that of either log booms or tows, but on the other hand, the draft of larger NOAA vessels is considerably greater than log booms and of many tows.

Table 8 MAJOR CHARACTERISTICS OF NOAA VESSELS PRESENTLY BASED IN LAKE UNION

CLASS	SHIP NAME	MAJOR DIMENSIONS				RATING OF OPERATIONAL CHARACTERISTICS				
		DISPLACEMENT, TONS	LENGTH, FT	BEAM FT	MAXIMUM DRAFT, FT (approx.)	ENGINE REDUNDANCY	MANEUVERABILITY BY PROPELLOR	MANEUVERABILITY BY THRUSTER	VISIBILITY FROM BRIDGE	FIRE PROTECTION
I	Oceanographer	3,805	303	52	20	Yes	Very Good	Excellent	Fair	Excellent
	Discoverer	3,805	303	52	20	Yes	Very Good	Excellent	Fair	Excellent
	Surveyor	3,150	292	46	19	No	Fair	Fair	Fair	Very Good
II	Fairweather	1,800	231	42	14	Yes	Excellent	Excellent	Fair	Excellent
	Rainier	1,800	231	42	14	Yes	Excellent	Excellent	Fair	Excellent
	M. Freeman	1,800	215	42	20	No	Fair	Good	Fair	Excellent
III	McArthur	995	175	38	12	Yes	Excellent	None	Good	Good
	Davidson	995	175	38	12	Yes	Excellent	None	Good	Good
V	Cobb	250	94	25	14	No	Fair	None	Excellent	Fair
	Oregon	410	100	26	12	No	Fair	None	Excellent	Fair

Source: Appendix 4.

Overall the NOAA fleet is superior to commercial fleets, notably with respect to system (power plant, navigational aides, steering and bridge control) quality and redundancy. The overall quality of the vessels undoubtedly contributes significantly to the excellent safety record (only one reportable accident in 19 years, and that not a major accident) of the fleet operation. Not unexpectedly, the older ships in the fleet are only marginally superior to their commercial counterparts. The two Class V vessels, the Cobb and Oregon, built in 1950 and 1946, respectively, are more than adequate in performance capabilities in relation to their size (roughly, commercial fishing vessels). The Class I Surveyor, built in 1960, inherently lacks features found in other larger NOAA vessels. However, NOAA, and the skippers assigned to the Surveyor, recognize these limitations and accommodate to them by special handling and scheduling practices.

It should be noted that the larger the vessel the greater the requirements for maneuvering room, stopping distance, etc. Larger vessels in the NOAA fleet, to a considerable degree, overcome this inherent limitation by the use of twin screws, which allows the skipper to change direction rapidly by changing the rotation (and, in some vessels, the pitch) of the propellor and by the use of auxillary thrusters which can add additional directional thrust, useful in "tight" situations.* On the other hand, the visibility from the larger ships from the bridge, particularly for small objects (such as swimmers or small boats) in the waters just in front of them is relatively poor. However, the use of "spotters" largely eliminates this problem. The distance required for NOAA vessels to come to a complete stop under emergency conditions while traveling at low speeds is, at this time, conjectural. Based upon an estimate prepared by Commander Speer (Ref: Speer to Townsend, Class I Ship Data, 1 September 1977), stopping distances from 4 knots, calculated from sea trial data, were made for the Surveyor (a single screw Class I ship) and the Oceanographer (a twin screw Class I ship) were: 550 feet and 200 feet, respectively. The Surveyor is one of the oldest vessels in the NOAA fleet and the only Class I vessel with a single screw, accounting for the considerably higher estimated stopping distance. It is intended, prior to any regular transit of the Lake Union to Lake Washington segment of the LWSC, to conduct trials at low speeds to determine stopping distances and stopping characteristics of all NOAA vessels. These trials would then give skippers additional information on which to act in the transit of this passageway.

Some concern has been expressed in years past that the wake generated as NOAA ships move through Lake Washington Ship Canal might swamp houseboats, small craft, swimmers, etc. NOAA captains, cognizant of this and other concerns, have for several years traditionally maintained the speed of

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*The effect of thrusters is most pronounced at very low speeds (<1 knot), and decreases with increasing speed.

its larger vessels within the LWSC at about 4 knots, although the allowable speed limit is 7 knots. In a study prepared by Nickum and Spaulding Associates, Inc., Naval Architects, for the Seattle District Corps of Engineers, an extensive study of the observed and theoretical wake generated by the largest of the NOAA vessels was undertaken. The author concludes that "the wake and wake action of the large Class I NOAA vessels, where traveling at a 4 knot speed, will have less affect on other commercial traffic, recreational traffic, and existing shoreline installations than a 45 foot power cruiser traveling at the lawful 7 knot speed in the waterway." These conclusions by Spaulding appear to be largely justified by the record. In the list of NOAA vessel mishaps (Appendix 6), only two incidents allegedly involving wake damage are found, and both are minor in nature. Neither involved houseboats. Thus, it is concluded that wake damage from NOAA vessels transiting the LWSC has not been shown to be a serious concern.

Operation of these vessels at cruising speeds in Lake Washington would, of course, generate larger wakes but, in that larger and deeper body of water, are likely to be of only minor consequence, to either other craft or to shoreline properties. (The numerous small recreational craft, many of which operate at high speeds, likely cause more wake problems).

NOAA vessels presently navigate the LWSC visually, as do other vessels. Although all NOAA vessels do have a capability to navigate the LWSC using onboard navigational aids, there is no requirement to do so.

Pilots are rarely used by NOAA vessels in the LWSC (the few "foreign" commercial vessels which now use the LWSC do use pilots routinely). Since NOAA skippers are rotated fairly frequently (about every two years), the new skipper normally undergoes at least one indoctrination passage of the waterway to insure familiarity with these waters.

NOAA vessels are inspected annually by a team from NOAA headquarters who are independent of the local jurisdiction. The criteria are generally equivalent to those applied by the Coast Guard to commercial vessels.

Dockside spills have been small over the years of NOAA's operations at its present location on Lake Union. Small spills could occur in future operations since some internal transfer of fuel (for ballasting purposes) and pumping of bilges and/or holding tanks to shoreside disposal facilities is routinely done. However, the maintenance of a boom around moored vessels is considered adequate to contain any small spills that might occur (see Zabrinski to Spearman, COE - Oil Spills at PMC).

Collision or ramming in which the hull is penetrated can release oil from one or more fuel tanks. This eventuality is described as the "maximum credible" spill when such a rupture causes complete loss of the contents of

the two largest adjacent fuel tanks.* The maximum credible spill for each of the NOAA vessels has been calculated and is reported in Appendix 4.

PMC currently has a directive (PMC Directives Concerning Water Pollution) which contains the elements of an oil spill contingency plan. A complete contingency plan would be prepared for any new facility and, like the present directive, would include the following sections: prevention, containment, cleanup and restoration. Presently PMC has, in addition to a 6 inch slick-bar boom around all ships at dockside, sorbent materials which can be used to mop up small spills. A local cleanup contractor, such as Crowley, is called in for larger dockside spills. Such specialists, who have extensive equipment, would use skimmers and other conventional techniques for such cleanup. If a NOAA vessel were to contribute or cause a larger spill (>2,500 gallons), the resources of the Puget Sound oil spill cooperative, Clean Sound, would be called upon (on a contract basis since NOAA is not a member); Clean Sound would, in turn utilize the various resources in the area. The Coast Guard's National or Regional Response Team would also be available if required. Normally such massive action would only be required if a loaded tanker or tank barge were involved).

Spills caused by NOAA vessels or NOAA operations would likely be light fuels such as diesel #2. Such materials, although they disperse quickly, leaving little visual residues, are difficult to contain and to clean up. And such materials are toxic to both flora and fauna. Hence, quick response after a spill to minimize damage to the environment is essential. Present plans should be reviewed with this concern, that is rapid response, in mind.

Larger NOAA vessels, as shown in Table 8, and Appendix 4, have good onboard fire detection and suppression capabilities. If, however, an uncontrolled fire were to occur, additional firefighting capability could be drawn from existing shoreside fire departments or from fireboats which are located at several points in Puget Sound. Smaller boats can also be readily provided with pumps for additional waterside suppression capability. However, aside from the two Class V vessels which are of wood construction, NOAA vessels have a low fire potential and such resources are unlikely to be required.

OFFICERS AND CREWS

Senior officers and chief crew members on NOAA vessels are considered to be well qualified and with adequate experience. The qualifications of candidates for commanding officer or executive officer, that is

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*The use of the maximum credible spill concept is useful in comparing the relative ranking of various vessels; however, it is not an indication of the likely size of spill if collision or ramming does occur nor is it any indication of the likelihood of such accident occurring. For example, no NOAA vessel has ever sustained a hull rupture leading to an oil spill.

those responsible for the safety and operation of the ship, are reviewed by a joint committee comprised of the head of the National Ocean Survey (which is responsible for ship operations) and the director of the NOAA officer corps. Typically the officers selected are of the rank of captain and commander for the larger vessels and commander and lieutenant commander for the smaller vessels. However the Class V vessels are now commanded by licensed civilian masters and first mates who fall under the Wage Marine Personnel category. Most crew positions on NOAA vessels are filled by Wage Marine Personnel, similar to civil service employees of the U.S. Government.

NOAA officers, like military officers, are reviewed annually for performance and for advancement. Because of this unusually close scrutiny, at least as compared to civilian masters, commissioned officers can be expected to be exceptionally careful in their operations, not wishing to blemish their records and opportunities for advancement. This desire to maintain a "clean record" as well as recognizing a responsibility for public safety may also account for some differences in the viewpoint of NOAA officers on the relative risks associated with the transit through the LWSC. These officers do have, by the very virtue of their placement, a fine record and a strong desire to maintain such a record. On the other hand, commercial masters, while certainly not wishing to blemish their records, are more motivated by economic incentives such as minimizing transit times and maximizing loads to maximize the profit to the ship's owner. Hence the civilian masters may tend to be less cautious in undertaking transits which have a higher degree of risk than normal. The differences between these two philosophies is not be be construed as approval of either; rather it is an intangible difference which must be recognized.

IV. MAJOR MITIGATING MEASURES

Mitigating measures refer to changes in operations, procedures, or hardware, either on NOAA vessels or elsewhere with the intent of reducing either the frequency or the consequences of perceived risks. Mitigating measures for candidate sites with direct access to Puget Sound are relatively simple and have been described in general terms (which is all that is possible at this time) in Section 3. However mitigating measures which may be applied to the proposed transit from Lake Union to Lake Washington have been the subject of considerable previous investigation and discussion and will be presented in some detail herein. The list of mitigating measures presented in Table 9 has been compiled from the data bases of Appendix 1 and 2 and from the author's own inputs.

The candidate mitigating measures shown in Table 9 are extensive and all are not of equal value. Further, many because of their nature, effect not only current or proposed NOAA operations but operations of many or all of the other users of the Lake Washington Ship Canal. Hence many of these mitigating measures are not under direct control of NOAA and would require cooperation and approval of other agencies and, in some cases, of the general public.

Mitigating measures may have adverse as well as beneficial consequences; these have been noted. In two cases the adverse consequences are sufficient to require special discussion.* In the first case, it has been proposed to limit the speed of all NOAA vessels in the LWSC to the maximum of 4 knots (under present operations, larger NOAA vessels voluntarily limit their speed in the LWSC to about 4 knots). A mandatory limitation on speed can, under some circumstances and with some vessels, reduce maneuverability characteristics to an unsafe level. Hence this proposed mitigating measure should, as with existing practice, limit speed in the LWSC to about 4 knots. Further, the Class V NOAA vessels, which are similar in many respects to commercial fishing vessels have no demonstrated requirement to limit their speed to 4 knots and should be allowed to proceed up to the legal limit of 7 knots as do other commercial vessels of comparable size.

In the second case it has been suggested that NOAA vessels not only continue the present practice of avoiding any bridge openings between the hours of 7 and 9 a.m. and 5 and 7 p.m. on weekdays (to accommodate surface rush-hour traffic) but, that NOAA vessels also not transit the LWSC other than in daylight hours. Other commercial vessels do transit the LWSC in the evening and even nighttime hours without particular difficulties. NOAA vessels also have made the transit to Lake Union in the evening and nighttime hours safely and without any particular difficulty (the FEIS, at one

*Both mitigating measures are proposed in the Corps of Engineers Dredging Permit for the Sand Point facility.

Table 9 CANDIDATE MITIGATING MEASURES FOR LWSC FOR NOAA VESSEL TRANSITS

PROPOSED MITIGATING MEASURE	RESPONSIBLE* AGENCIES	MAJOR CONSEQUENCES	
		BENEFICIAL	ADVERSE AND/OR PROBLEMS
NOAA Vessel Operation			
Limit speed in LWSC to 4 knots	NOAA	Reduces wake, lessens collision effects	May reduce larger vessel maneuverability; unnecessary on smaller vessels.
Limit hours of transit			
o to daylight only	NOAA	Reduce nighttime risks	Requires careful scheduling on the part of the skipper
o to low-peak bridge usage	NOAA	Less inconvenience to motorists	
o to low-peak recreation usage	NOAA	Less risks to boaters and to NOAA vessels	
Restrict movement when foggy or wind exceeds 20 knots	NOAA	Decrease risk of collision, ramming, etc.	Requires lay-by at standby berth
Determine stopping and maneuvering characteristics of NOAA vessels at low speeds	NOAA	Provides skippers with needed information (however, such data are normally not available for commercial vessels)	--
Increase navigational skills--			
o Use pilots routinely	NOAA	Familiarity with transit might improve safety	Pilots unfamiliar with NOAA vessels.
o Familiarize new skippers with trial runs of LWSC & LW	NOAA	Reduce possibility of accident due to non-familiarity with transit	--
Modify Surveyor to enhance maneuverability	NOAA	Improve low speed handling characteristics	Requires approval and funding
Bridge Openings			
Establish radio communications between ship and bridge tender	NOAA; City of Seattle; BNRR	Provides greater assurance of bridge opening; lessens chance of ramming bridge or channel	Requires cooperation of involved agencies
Develop procedures and training to bring all traffic control in LWSC under central jurisdiction	NOAA; City of Seattle; BNRR; COE	Could allow scheduling of NOAA transits in in trafficless "windows"	Complex
Traffic Control			
Portage Cut --			
o Larger traffic lights at either end	COE	Warn small boats; reduce likelihood of larger vessel ignoring lights	Requires COE action
o Subject all vessels to traffic lights	COE, CG	Reduce possibility of collision, ramming	Difficult to enforce
o Bow watch standers while transiting LWSC	NOAA	Alert skipper to small craft, swimmers	--

Table 9 CANOIDATE MITIGATING MEASURES FOR LWSC FOR NOAA VESSEL TRANSITS
(continued)

PROPOSED MITIGATING MEASURE	RESPONSIBLE* AGENCIES	MAJOR CONSEQUENCES	
		BENEFICIAL	ADVERSE AND/OR PROBLEMS
o Use "advance boat" to warn boats when recreational traffic is heavy	NOAA	Alert and assist small boats, allowing safer vessel passage	--
o Redundant traffic light at Webster Point to allow one way traffic through Union Bay Reach	COE	Would avoid passing larger vessels in Union Reach	Not seen as necessary by some agencies
o Place "camels" along sides of cut	COE	Would prevent vessels experiencing a break-down from ramming cut walls	Would further limit passing room and increase number of swimmers
o Provide a traffic light at the exit from the U of W Waterfront Activity pier at the west end of the cut	COE	Would allow small craft (canoes, kyaks) to safely gauge crossing to Arboretum area	Could cause traffic jams when recreational traffic is heavy
All or part of LWSC --			
o Extend Puget Sound VTS to encompass LWSC & LW	CG	To better control vessel movement	Complex
o Lower speed limit for all vessels over 40 foot length	COE, CG	Reduce risk of collision	Affected users might object
o Reduce weight limit on traffic control through Fremont Cut to 100 tons	COE, CG	Reduce conflicts between vessels moving in opposite directions	Requires COE action
Fixed Navigational Aids			
o In Portage Bay Reach	COE	Oelineates large vessel channel more clearly	Requires COE action
o In Union Bay Reach	COE	Oelineates large vessel channel more clearly	Requires COE action
Other			
o Require licensing of small boat operations	State of Washington; CG	Would reduce number of reckless boaters, increasing safety for all users	Politically sensitive
o Oredge shoal at west end of Portage Cut	COE	Would provide maneuvering and lay-by room for larger vessels entering Portage Cut.	Cost
o Provide a standby berth for NOAA vessels outside LWSC in case of late arrival or inclement weather	NOAA	Would mitigate need for skipper to follow tight schedule through northern Puget Sound	Cost and berth availability

*COE = U.S. Army Corps of Engineers
CG = U.S. Coast Guard
NOAA = National Oceanic and Atmospheric Administration

point, mistakenly indicates that nighttime operations would require additional lighting). If both of these restrictions were made mandatory, a potentially unsafe condition can be foreseen; namely, placing pressure on the skipper of an incoming NOAA vessel to reach the Chittenden Locks sufficiently early in the afternoon to ensure arrival at the PMC base prior to night fall. This condition would most likely arise in the winter months when the days are short and night fall occurs prior to 7 p.m. In toto, restrictions on movement after dark in the LWSC has no demonstrated beneficial consequence and could increase the probability of accident on the inward passage. Hence, this mitigating measure, that is, of restrictions on nighttime movement, is of dubious value. (It should be noted that NOAA vessels schedule their arrival at Shilshole Bay in the morning or early afternoon hours whenever possible. However, exceptions do occur and these exceptions should be accommodated).

Further detailed discussion of the various proposed mitigating measures will not be presented here but can be found in the references listed in Appendix 1.

In conjunction with the quantified navigational risk analysis which follows, mitigating measures which would have significant impacts on perceived risks were identified. These risks were placed into groups or packages with common characteristics to simplify the analysis. Package I consists of mitigating measures which reflect current practice. Package II consists of mitigating measures which can be instigated by NOAA itself or are presently in the process of being implemented. Package III includes mitigating measures which would require action by other government agencies and which, in general, would impinge on other users of the LWSC and, in some cases, could entail considerable costs. These three packages which are summarized in Table 10 will be used in the navigational risk analysis section.

Table 10 MITIGATING MEASURE PACKAGES IN LWSC

Package	Mitigating Measures	Notes
I	o Limit speed of larger NOAA vessels to about 4 knots	Measures now generally in force.
	o Bridge opening constraint	Measures now generally in force.
	o Familiarize new skippers with LWSC transit	Measures now generally in force.
	o Restrictions on travel in severe weather	Measures now generally in force.
II	Package I +	
	o Radio communication capability between vessels and bridge tenders	Radio communication capability now being installed on City of Seattle bridges
	o Alternate berth for NOAA vessels outside of LWSC	An alternate berth in Salmon Bay would also be acceptable
	o Determine maneuvering characteristics of larger NOAA vessels at low speeds	
III	Package II +	Package requires changes in rules and regulations involving the Corps of Engineers and Coast Guard
	o Portage Cut	
	- Large lights at either end - Traffic control for all vessels or use of advance boat when boat traffic is heavy	The use of an advance boat to alert small boat traffic can be instituted with minimal effort and would provide "fair warning" to small boat operators
	- Dredge west of entrance	
	o Fixed navigational aides in Portage Bay Reach and Union Bay Reach	

V. NAVIGATIONAL RISK ANALYSIS FOR THE LAKE WASHINGTON SHIP CANAL

An analysis which quantified risks for various sites within the Lake Washington Ship Canal was made to determine if differences existed and, if these differences were sufficient to rule out one or more candidate sites. The type of analysis used relied upon subjective evaluation since historical accident data were extremely limited and of indeterminate quality when available. However, to maximize the utility of the analysis, inputs which required subjective evaluation were disaggregated initially as far as possible so that any given input would not unduly skew the final aggregated result.

The major components of the risk analysis are shown in Table 11. Locational risk is defined for each major feature though which a NOAA vessel would have to pass in the transit from Shilshole Bay to Lake Washington. Features were considered in three major categories: open waters such as Shilshole Bay; restricted waters such as Fremont Cut; and physical barriers such as the Ballard Bridge. For each feature, the type of accident (for example, ramming a bridge), which might be associated with the passage of a NOAA vessel through the feature, was considered. Finally, the perceived risk from such an accident assigned to the NOAA vessel itself, to other vessels which might be involved, to persons and/or to shoreline property. The locational risk for a given feature then was obtained by summing all of the individual disaggregated risks (an example will be given later).

The safety weighting factor describes the relative maneuverability of NOAA vessels moving at slow speeds and is an index of relative safety. The basic premise is that large ships are more difficult to maneuver than are small ships. The safety weighting factor has been developed for each class of NOAA vessels, reflecting the characteristics of individual ships in that class.

The frequency of exposure to risk is based upon the number of transits which each class of NOAA vessel will make through each feature over a period of time. The probability of accident, all else being equal, is directly proportional to the number of transits.

The final value to be determined is the operational risk which is derived as follows:

$$\text{Operational Risk} = \text{Locational Risk} \times \text{Safety Weighting Factor} \times \text{Exposure} \qquad \text{EQ. 1}$$

The derivation of each component will be described briefly below.

Table 11 COMPONENTS OF THE RISK ANALYSIS

Locational Risk

- For each feature (open water, constricted water, bridge, etc.) through which passage is required.
- Considers accidents which could result from
  - Collision with
    - Commercial vessels
    - Recreational craft
  - Ramming of
    - Bridges
    - Other fixed objects or channel wall
  - Grounding
  - Wake damage to
    - Houseboats
    - Small craft or swimmers
- Estimates consequences of accident to
  - NOAA vessels
  - Other vessels (commercial and/or recreational)
  - Persons (life and limb)
  - Other (on shore) property
- Considers differences in risk for summer and winter conditions.
- Quantifies accidents as to estimated frequency of occurrence and magnitude of the consequences.
- Considers mitigating measures which can be applied to reduce the frequency or consequences of perceived risks.

Safety Weighting Factor

- Provides, for each class of NOAA vessels, a relative ranking covering
  - Ease of maneuverability in restricted waters
  - The spatial requirements as related to breadth and draft

Table 11 COMPONENTS OF THE RISK ANALYSIS

Frequency of Exposure to Risk

- Provides projections on frequency of transit, through each locational risk feature, by
  - Class of vessel
  - Season
    First quarter (Jan., Feb., March) when recreational activity is minimal.
    Third quarter (July, Aug., Sept.) when recreational activity is maximal.

Operational Risk

- Provides a numerical rating for each candidate site, of the perceived risks of long-term operations for
  - Winter and summer conditions
  - Average condition

LOCATIONAL RISK

Risk has two major components: frequency and magnitude of the consequences. The combination of these two components determines both the seriousness of the risk and its overall acceptability. For example, if both the frequency and the consequences are low, the risk is generally considered inconsequential and acceptable. If on the other hand the frequency is low but the consequences are high (for example, the risk of living in earthquake prone country) the risk may be tolerated. Using these two components, a simple model, shown in Figure 15, was developed for this analysis. In this model values ranging from 1 (the lowest risk) to 10 (the highest risk) have been assigned based upon both frequency and consequences. (No risks with a value of 9 or 10 were identified in the course of this analysis.) In the evaulation, subjective judgment (based upon an understanding of the problem and, where available, accident rate data) were used to assign appropriate values. For example, if the likelihood of hitting the Burlington-Northern Railroad (BNRR) Bridge was seen as occurring once in 100 years and resulting in substantial damage to both the ship and the bridge (a worst case condition was normally considered), then a value of cX was assigned with an associated numerical value of 6. Any other risk can be similarly coded and valued.

The manner in which locational risk was determined is best illustrated by an example. The headings in Table 12 include the parameters just discussed and are the basis for the locational risk analysis. For the first location, Shilshole Bay, the perceived risk to NOAA vessels (N) from collision with commercial vessels is coded as bX, with a value (from Fig. 15) of 4. Similarly, the perceived risk to persons (L) for this same type of accident is coded as aX with a value of 2. Other values are similarly determined for each possible type of accident within Shilshole Bay and totaled (in this case, 33).

The next feature, the BNRR Bridge is similarly evaluated resulting in a total of 16. The cumulative total (i.e., 33 + 16 = 49) then represents the risk accrued by a NOAA vessel passing first through Shilshole Bay and then through the BNRR Bridge. The locational risk for any candidate site then, is the cumulative total of all the features which must be transited in order to reach the candidate site. Appendix 5 lists the assigned values used in the analysis. Values are given for a winter and summer condition and for the three mitigating packages described in Table 10 (the example above was for mitigating measure Package I and for the summer season).

A summary of the locational risks for all cases is shown in Table 13.

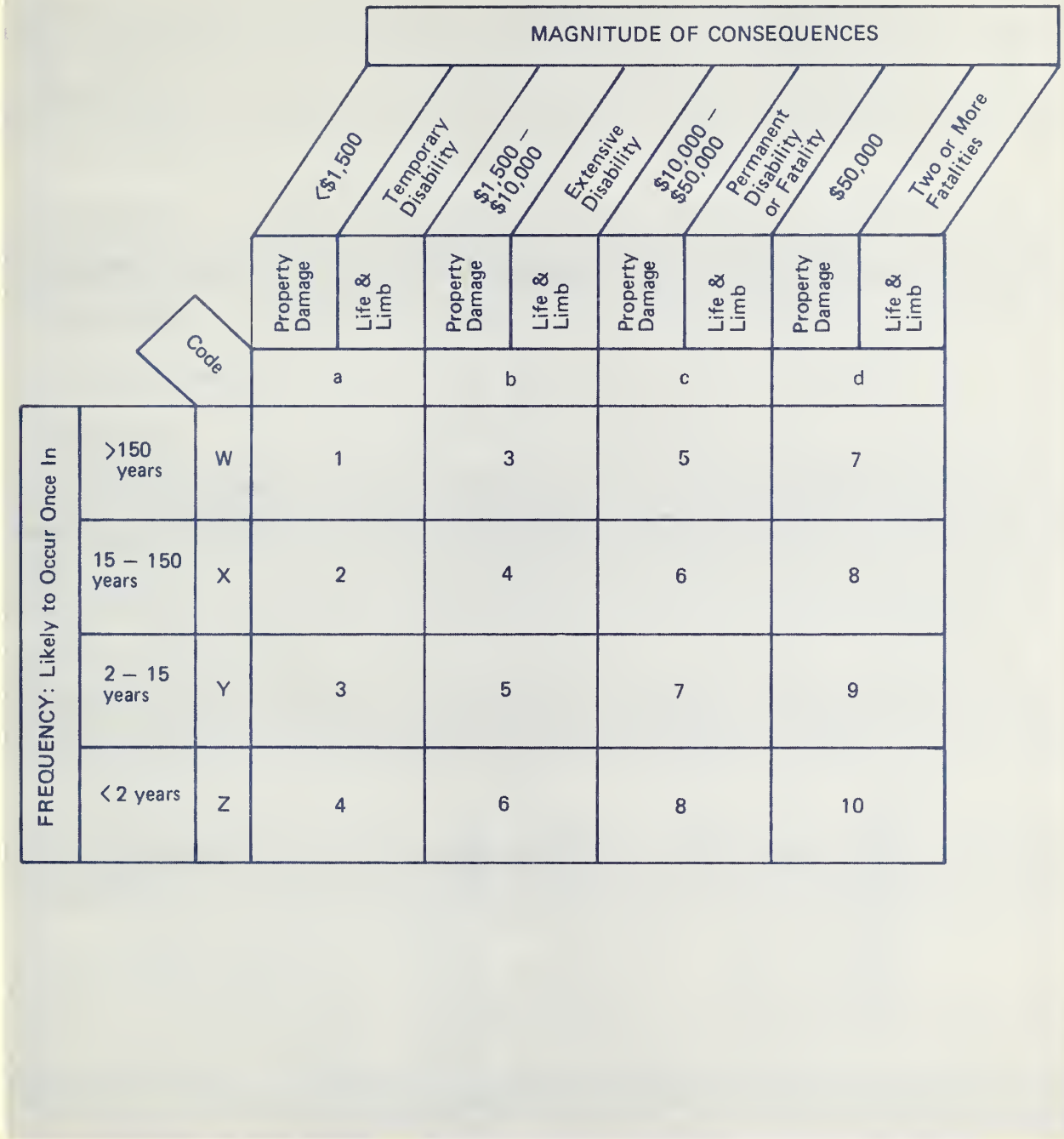


Figure 15

Composite Risk Values Derived from Estimated Frequency of Occurrence and Consequences to Property and/or Life and Limb

Table 12 EXAMPLE MATRIX FOR DETERMINING LOCATIONAL RISK

Location	Risk*	Collision With**				Ramming								Subtotal				Total	Cumulative
		Commercial Vessels				Recreational Boats				Bridges				Channel				Grounding				Wake Damage								N+O+L+P	Total
		N	O	L	P	N	O	L	P	N	O	L	P	N	O	L	P	N	O	L	P	N	O	L	P	N	O	L	P		
Bay	M	b	b	a	-	a	c	b	-									b	-	a	-	-	a	-	-						
	F	x	x	x	-	y	y	y	-									x	-	x	-	-	x	-	-						
	V	4	4	2	-	3	7	5	-									4	-	2	-	-	2	-	-	11	13	9	-	33	33
BNRR Bridge	M									c	-	b	c																		
	F									x	-	x	x																		
	V									6	-	4	6													6	-	4	6	16	49
Chittenden Locks	M	a	b	-	-	a	b	b	-					b	-	-	a														
	F	x	x	-	-	x	x	w	-					x	-	-	x														
	V	2	4	-	-	2	4	3	-					4	-	-	2									8	8	3	2	21	70

* From Figure 12
M = magnitude of consequences, estimated
F = frequency of occurrence, estimated
V = corresponding numerical value

**Recipient of Risk
N = NOAA vessels
O = Other vessels
L = Persons (life and limb)
P = Shoreside property

Table 13 SUMMARY OF VALUE OF CALCULATED LOCATIONAL RISKS

Location	Mitigating Measure Package					
	I		II		III	
	S	W*	S	W	S	W
Shilshole Bay	33	27	33	27	33	27
BNRR Bridge	16	16	10	10	10	10
Chittenden Locks	21	17	21	17	21	17
Salmon Bay	30	23	30	23	30	23
Ballard Bridge	13	13	8	8	8	8
Fremont Cut	37	27	37	27	37	27
Fremont Bridge	22	22	13	13	13	13
Lake Union	31	25	31	25	31	25
University Bridge	37	37	19	19	19	19
Portage Bay Reach	27	18	27	18	22	14
Portage Cut	55	38	55	38	34	26
Montlake Bridge	16	16	9	9	9	9
Union Bay Reach	45	31	45	31	30	23
Lake Washington						
o Sand Point	30	23	30	23	30	23
o Kenmore	35	26	35	26	35	26

* S = Summer season
W = Winter season

SAFETY WEIGHTING FACTOR

The safety weighting factor accounts for the operational characteristics shown in Table 8 and the navigational constraints posed by vessel size in constricted waters, as shown in Figure 13. Considerable variation for the safety weighting factor can occur within a given vessel class. Most notably in Class I the Oceanographic and the Discoverer, sister ships, have twin screws plus through the hull-bow thrusters which, in toto, make these ships handle well despite their sizes. On the other hand, the Class I Surveyor, which is almost as large, has a single screw and a much less effective stern mounted Harbormaster; its handling characteristics, and hence its ability to maneuver safely in tight quarters, are more limited. Differences between vessel classes are accounted for by the use of safety weighting factors, namely:

Class	Safety Weighting Factor
I	1.2
II	0.75
III	0.5
V	0.3

EXPOSURE TO RISK

Frequency of transit was derived from available data (shown graphically in Figure 5) and two cases were selected for evaluation: first quarter (Jan-Feb-Mar) when large ship transits are lowest and third quarter (July-Aug-Sept) when large ship transits were highest. These quarters also coincide closely with minimum and maximum recreational uses of the waters of LWSC. The first quarter, then, constitutes a best case and the third quarter a worst case.

The projects transits (one-way trips) per quarter to either consolidated or split site alternatives used were:

	Class			
	I	II	III	V
Summer	11.5	13	3	7.5
Winter	7.5	4.5	5.5	11.5

Annual Total = 120*

*Represents a worst case through the year 2000.

An average seasonal value was used for the split site with staging pier at Sand Point option. These values, for transits per quarter, were:

Class			
I	II	III	V
2.5	1	1.5	1

Annual Total = 20*

OPERATIONAL RISKS

Operational risk was determined for each candidate site and for each option using the methodology and the values just described and applying equation (1). The total values calculated by this procedure are shown in Table 14. These values were then averaged (where both summer and winter cases were determined) and normalized using the split site alternative at Lake Union, mitigating measure package No. 1 as the base (this represents the present operation on Lake Union). These average normalized values are displayed in Figure 16.

Figure 16 which expresses the deviation from the existing operation on Lake Union, clearly shows the increased risk associated with any operation on Lake Washington even when various mitigating measures are applied. Although differences between the Sand Point and Kenmore sites were recognized and initially determined, these differences were masked by the much larger cumulative risk values. Hence, in this discussion the two sites are not differentiated (differences are noted in Section VI). Again, not surprisingly, the split site alternatives at Salmon Bay show a marked decrease in risk over the present operation at Lake Union. Each split site alternative with the optional staging pier at Sand Point resulted in an increase in the risk but, still lower than the consolidated sites on Lake Washington proper. It is noteworthy, however, that the proposed mitigating measures, which were directed at reducing risks in the transit to Lake Washington, were according to this analysis, quite effective. Mitigating measures, being directed at the eastern portion of the canal, were naturally of little consequence in their effect on locations in either Lake Union or Salmon Bay.

In summary, this analysis has shown significant differences between the various sites and options.

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*Represents a "worst case" condition through the year 2000.

TABLE 14. CALCULATED VALUES FOR OPERATIONS RISKS AT VARIOUS CANDIDATE SITES

Candidate Site	Mitigating Measure Package I S*	I W	II S	II W	III S	III W
Consolidated						
Sand Point	11,275	6,185	10,046	5,349	8,927	4,903
Kenmore						
o Average	8,730 (2.01)		7,698 (1.77)		6,915 (1.59)	
Split						
	2,136 (0.49)		1,998 (0.46)			
Salmon Bay	2,730	1,542	2,566	1,430		
Lake Union	5,542	3,158	4,995	2,786		
	4,350 (1.00)		3,890 (0.89)			
Split w/Staging						
Salmon Bay	3,487 (0.80)		3,110 (0.71)			
Lake Union	5,245 (1.21)		4,664 (1.07)			

* S = Summer
W = Winter

NOTES:
(1) Values are determined in non-dimensionless units from Equation 1, and have not been rounded.
(2) Values in parentheses indicate risk relative to present PMC operations.

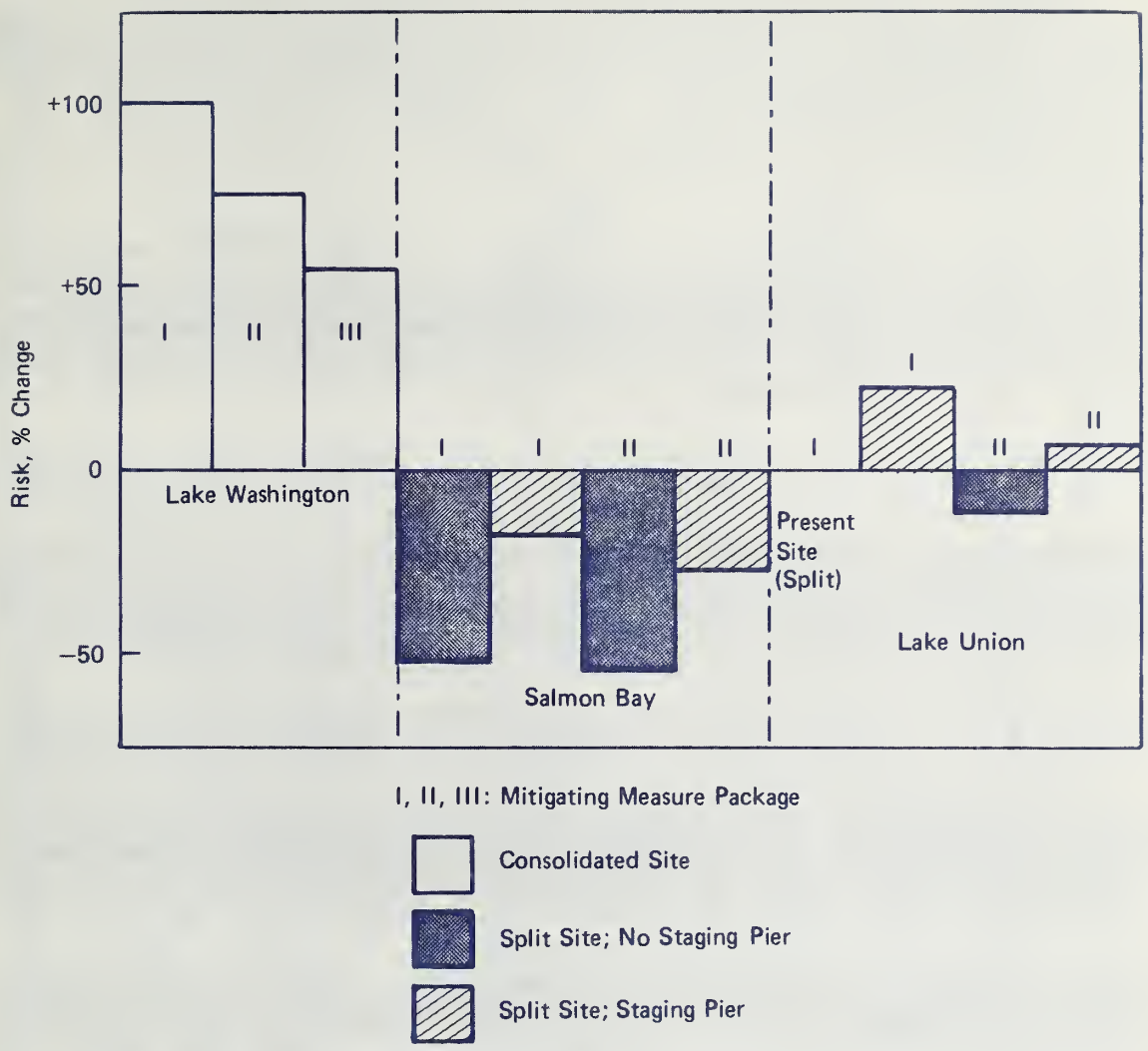


Figure 16

Comparison of Risk for Alternative Sites and Options within the Lake Washington Ship Canal

VI. COMPARISON OF CANDIDATE SITES

Accident rates provide a convenient and meaningful comparison of the navigational risks at alternate sites. Only historically-derived accident rates were used for comparative purposes but the same data base could not be used for all candidate sites. The differences in the data bases are shown below:

Candidate Sites	Years Covered	Type Vessels	Derivation
Everett	1974-1977	Freighter > 18 ft. draft	Direct - from CG & COE data on the port
Tacoma	1971-1977	"	"
Manchester	1971-1976	"	Indirect - from CG & OIW data on similar ports
Mukilteo	1971-1976	"	"
LWSC (all)	1974-1977	All commercial	Direct - from CG & COE data on the port
LWSC (all)	1971-1976	Freighters > 18 ft. draft	Indirect - from CG & OIW data on similar ports

These data bases were used, as described in Section II, to arrive at a "base" accident rate, representative of existing conditions. The base rate was then "fine tuned" to account for factors which might add to or decrease the base accident rate (Table 15). Consideration was given to possibility of collision with either commercial or recreational vessels, ramming (bridges, but not piers), and grounding. This fine tuning was intended to reflect accidents which would be of special concern to NOAA operations in transit to or at the candidate site. Since some value judgments were used in assigning base rates, the criteria used will be described:

Everett: A base rate of 2.0 accidents per 1,000 port calls, slightly higher than the value noted in Table 6 (that is, 1.8), has been used to be on the conservative side, the higher value was chosen. No other factors were identified in the risk assessment which would modify the base rate so the adjusted rate is identical; that is, 2.0 accidents per 1,000 port calls.

TABLE 15. COMPARISON OF CALCULATED FREIGHTER ACCIDENT RATES AT CANDIDATE SITES

Candidate Site	Base Rate	Rate Attributable To: Collision Com.	Collision Rec.	Ramming	Grounding	Adjusted Rate
Everett	2.0	0	0	0	0	2.0
Mulkiteo	1.5	0	0	0	.1	1.6
Manchester	1.5	.1	0	0	.1	1.7
Tacoma North	5.6	0	0	-.2	0	5.4
Tacoma South	5.6	0	0	0	0	5.6
LWSC	(2.0)					
o Salmon Bay	1.8	0	0	-.1	0	1.7
o Lake Union	1.8	0	0	.1	0	1.9
o Lake Washington	3.4	0	.2	.1	.1	3.8

Notes:

1) Rate is expressed in reportable accidents per 1,000 port calls where one port call represents two transits.
2) Base and adjusted rates are for freighters (>18 ft. draft) accidents. When applied to NOAA fleet operations, all rates should be reduced by one-third to reflect both NOAA and safety record and special handling characteristics of its ships.
3) Adjusted rates for LWSC sites, are based on Mitigating Measure Package I.

Mulkiteo: Since this candidate site presently has no commercial vessel activity, a base accident rate slightly below the average value derived from the OIW for small ports was selected. Because of the possibility of grounding at this site, the rate was increased, resulting in an adjusted rate of 1.6 accidents per 1,000 port calls.

Manchester: Since this candidate site presently has no commercial vessel activity, a base accident rate slightly below the average value derived from the OIW model for small ports was selected. The possibility of grounding and the routing of the Seattle-Bremerton ferry on the ingress to this candidate site resulted in an adjusted rate of 1.7 accidents per 1,000 port calls.

Tacoma: The experiential accident rate for the Port of Tacoma for a 4-year period was found to be 7.4 accidents per 1,000 port calls (Table 6). However, in reviewing the data and in comparing it with an addendum to the OIW Study, it was noted that this value may have been skewed by an unusually high number of accidents in the sample period, especially in 1976. Since data on accidents in the Port of Tacoma for the period from 1971-1973 were available (in the OIW addendum), these values were incorporated, providing a data base for the years 1971-1977, representing over 3,000 freighter port calls. The resultant rate, 5.6 accidents/1,000 port calls, reflects, as expected, the lower number of accidents reported in the years from 1971-1975. The value of 5.6 accidents/1,000 port calls was then used on the base rate for the Port of Tacoma.* This base rate was then adjusted for the north Tacoma site downward to 5.4 accidents per 1,000 port calls to reflect the fact that no bridge traversal was required.

LWSC: No freighter accident rate could be determined for the LWSC, no such accidents being reported. Rather an estimated rate of 2.0 accidents per 1,000 port calls -- slightly above the OIW average for small ports -- was used. Based upon the analysis in Section II, which reflects expected accident rates for ocean-going vessels using the waters of LWSC, base rates were assigned to the three candidate sites in the LWSC.

Salmon Bay: The base rate of 1.8 was decreased to 1.7 accidents per 1,000 port calls because the site requires transit through only one bridge.

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*Changes in accident rate as the data base increases are to be expected. However, caution must be exercised in extending the time frame since older data may reflect operational or navigational conditions which no longer pertain.

Lake Union: The base rate for Lake Union was increased to 1.9 accidents per 1,000 port calls because of the several bridges which have to be transited in arriving at this site.

Lake Washington: The base rate of 3.4 accidents per 1,000 port calls was increased to reflect the increased probability of accidents involving recreational vessels in the Portage Cut area, increased probability of bridge ramming and increased probability of grounding at the west end of the Portage Cut, resulting in an adjusted rate of 3.8.

The adjusted accident rates do show differences between candidate sites but leave unanswered the question: are these rates within acceptable limits? The definition of acceptable risk comes into play since, ideally, we prefer no accidents and no risk situations. Realistically, however, the "real world" involves risks. Normally an accident rate for a given situation which is relatively constant over time and which does not deviate markedly from the accident rate for similar situations, is assumed to be acceptable. In this framework, then, the projected accident rate for the NOAA candidate sites were compared with accident rates experienced by large and small port systems across the United States.

The Oceanographic Institute of Washington, in their pioneer study of freighter accidents in Greater Puget Sound (previously referenced), developed freighter accident rates for 7 large port systems (defined as all ports within a waterway or locale) and 9 smaller port systems. The results are shown in Table 16. The rate for larger ports averages 3.64 accidents/1,000 port calls with a standard deviation of ± 1.24. As would be expected, two major port systems (San Francisco and Los Angeles, interestingly, both areas on the West Coast), are more than one standard deviation removed from the average.

The spread in accident rates for smaller port systems is even greater than for large ports. By eliminating Searsport, Maine (which having experienced a single accident with a very low port call rate apparently has a very high accident rate), an average of 1.40 accidents/1,000 port calls with a standard deviation of ± 0.98 were found. Accident rates for the candidate sites are compared with the national average in Table 17.

From Table 17 it can be seen that all candidate sites except Lake Washington and the two Tacoma sites fall within one standard deviation of the national averages found by OIW. Lake Washington, being more than 2 standard deviations from the average for small ports, poses some questions as to acceptability of the risk at that location.* However,

*The application of mitigating measures, Package III, is estimated to reduce the risk, on the average, in the transit to Lake Washington by 20 percent over MM Package I. If MM Package III is instituted, the apparent rate drops to 3.0 accidents/1,000 port calls, well within two standard deviations from the average (about the same placement as San Francisco is to the average for large port systems).

Table 16 FREIGHTER ACCIDENT RATES AT SEVERAL MAJOR AND SMALLER PORT SYSTEMS IN THE U.S. (period 1969-1975)

Port System	Average Annual Port Calls	Accidents/1,000 Port Calls
New York	5,738	3.4
Delaware	2,671	3.2
Chesapeake	6,222	3.2
Gulf Coast	3,770	4.9
Los Angeles/Long Beach	2,773	1.7
San Francisco	2,815	5.5
Greater Puget Sound	2,004	3.6
Average/Standard Deviation	3,713 ± 1,638	3.64 ± 1.24
Searsport, Me.	41	10.3
Portsmouth, N.H.	24	0
Plymouth, Mass.	321	1.8
Fall River, Mass.	58	2.5
Charleston, S.C.	1,187	2.2
Savannah, Ga.	1,024	1.5
Miami, Fla.	1,238	1.0
Pensacola, Fla.	192	2.2
Crescent City, Ca.	128	0
Average/Standard Deviation	468 ± 522	2.38 ± 3.11
(without Searsport)	521.5 ± 531	1.40 ± .98

Source: OIW.

TABLE 17. COMPARISON OF ACCIDENT RATES FOR CANDIDATE SITES WITH NATIONAL AVERAGE ACCIDENT RATES

	Large Ports	Smaller Ports	Estimated Annual Port Calls*
National Average	3.64 ± 1.24	1.40 ± .98	(3,713 large) (522 small)
Tacoma-North**	5.4	--	575
Tacoma-South	5.6	--	575
Mukilteo	--	1.6	60
Salmon Bay	--	1.7	80
Manchester	--	1.7	60
Lake Union	--	1.9	72
Everett	--	2.0	187
Lake Washington	--	3.8	62

Note: Tacoma is treated as a large port because of associated barge and tanker traffic.

*Includes 60 port calls/year for NOAA vessels plus freighter (>18 foot draft) traffic.

it must be recalled that the risk values for all sites within the LWSC were derived indirectly and are used only as guidelines. For example, it might be argued that the apparent accident rate for Lake Washington should be lower, using the following reasoning:

> Based upon "best recollection" (primarily active and retired pilots), only one ship accident of any consequence (and that a tanker) has occurred in the movement of ocean-going vessels into Lake Washington over the years since before World War II. A "best guess" accident rate based on this "hearsay" data would be closer to 1.5 accidents/1,000 port calls.

The Port of Tacoma is within 2 standard deviations of the national average -- in about the same range as the San Francisco port system. Statistically, the accident rate value for the Port of Tacoma is within the normal range.

In an effort to determine if "criteria for acceptability of accident rates" were available, representatives of the shipping industry and ship underwriters were contacted (see Appendix 2). The concensus was that no standards exist for acceptable risk. However, an underwriter of hulls (ships are insured by their components) provided some interesting guidelines:

- Accidents, as such, have little meaning. Most important is the seriousness (magnitude) of the accident and, to a lesser extent, the cause of the accident.

- Concern is expressed if one ship (normally in a larger insured fleet) has more than two accidents/year.

- Underwriters do recognize some general locations (such as the Orinoco River) as higher risk, and in some cases may increase the premiums for ships regularly engaged in traffic to such higher-risk ports. However, no port system, regardless of its accident record, is "blackballed." (Further, individual ports are generally not considered; rather the area of concern is the general locale, such as Greater Puget Sound).

Since no recognized criteria for acceptability of risks levels at the candidate sites (or for any other port, in fact) was found, no conclusions in this regard can be drawn. It can be noted, however, that apparent accident rates are appreciably higher at candidate sites on Lake Washington and at Tacoma.

Although the risk assessment analysis has not eliminated any candidate sites due to unusually high navigational risks, it has delineated differences between them. As a potentially useful tool to the decision-maker, Table 18

TABLE 18. RANKING OF CANDIDATE SITES WITH RESPECT TO ESTIMATED ACCIDENTS TO NOAA VESSELS OVER FACILITY LIFETIME

Rank	Candidate Site	Rate,[1] Accidents/1,000 Port Calls	Estimated Number of Accidents to NOAA Vessels[2]
1	Mukilteo	1.6	2.6
2	Salmon Bay	1.7	2.7
3	Manchester	1.7	2.7
4	Lake Union	1.9	3.0
5	Everett	2.0	3.2
6	Lake Washington	3.8	6.1
	o with Mitigation (Package III)	3.0	4.8
7	Tacoma - North	5.4	8.6
8	Tacoma - South	5.6	9.0

NOTES:

[1]Assumes present practice (i.e., MM Package I) unless otherwise noted; values from "adjusted rate" column, Table 15.

[2]Assumes 60 port calls per year over a 40-year facility design life and a NOAA vessel accident rate which is 2/3 that of the base (freighter) accident rate.

Source: URS Company

has been prepared which ranks the candidate sites according to the number of "reportable" accidents, that is total damage exceeds $1,500, which might be anticipated over the 40 year design lifetime of the facility.* However, the table does not and cannot predict the severity of accidents which might occur nor the time frame in which they might occur because of the probabilistic nature of accidents (a series of reportable accidents might occur in a very short period followed by a very long period without accidents). It is evident that, all things being equal, candidate sites with low accident rates are to be preferred over ports with higher accident rates. On the other hand, it must be stressed that operations at any site does entail risk, and that the occurrence of accidents at any site cannot be ruled out. For this reason, as with any project, mitigating measures should be thoroughly considered initially and as the project progresses these should be, to the extent possible, incorporated to ensure that the project is as safe as possible.

The candidate sites can also be viewed in terms of the incremental impact of NOAA fleet location at each of them. Table 19 compares, for each site, the number of accidents, estimated for a ten year period, which can be attributed to NOAA fleet operations and to commercial freighter operations. The incremental impact of NOAA operations, in terms of projected accidents, is of course, greatest for those sites where existing traffic is light or absent; on the other hand, NOAA operations at busy ports, such as Tacoma, would have little incremental impact on the accident rate. The obviously greater incremental impact of NOAA operations at sites with presently low traffic volumes is not, however, the complete picture. Two additional factors must be considered; the benefits to be accrued from operations at the selected site and the "displacement of the risk" from sites which were rejected. Risk cannot be measured in absolute terms; it is only half of the equation; risk vs. benefit. That is, risk is never routinely accepted unless a substantial benefit is also anticipated. In the overall picture, then, the expected benefits for each site must be weighed against the perceived risks at the site. While such an assessment is not within the scope of this study, it must be remembered that, normally, greater risks can be tolerated where greater benefits are foreseen. In this perspective, candidate sites cannot be eliminated on the basis of either higher than average base accident rates or incremental impacts.

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*In Table 18, the adjusted accident rates from Table 15 are used. The reader is reminded that this "adjusted rate" does not statistically differentiate any candidate site from the comparable national average. However, "large ports", such as Tacoma, would be expected to have a statistically significantly higher accident rate than would "small ports".

TABLE 19. BASE AND INCREMENTAL ACCIDENT RATES

Site	Estimated Number of Accidents Over a Ten Year Period	
	Freighters*	NOAA**
Mukilteo	0	.64
Salmon Bay	.34	.68
Manchester	0	.68
Lake Union	.23	.76
Everett	2.54	.80
Lake Washington		
o MM Package I	.08	1.52
o MM Package III	--	1.20
Tacoma North	28.35	2.16
Tacoma South	29.40	2.24

NOTE: Values are expressed to two decimal places for comparative purposes only. Only one decimal place is warranted by the data used.

*Accident rates and freighter traffic projections based on Table 17.
**Accident rate for NOAA vessels assumed to be two-thirds that of the base (freighter) rate.

The second factor, displacement of risk, is difficult to quantify, but is, nonetheless, a consideration. The selection of one site, while raising the incremental impact at that site, simultaneously reduces the potential incremental impact at all other sites. It can be argued on this basis, that by "spreading the risk" (for example, placement of the NOAA fleet at Mukilteo with a low estimated accident rate as against Tacoma with a higher accident rate), the overall risk (in this case to Greater Puget Sound), would be lowered. No matter what candidate site (including the present location) is selected, the possibility of a reportable accident involving a NOAA vessel remains. The potential for accident, regardless of how low, is an unavoidable impact associated with the proposed project.

VII. CONCLUSIONS AND RECOMMENDATIONS

Major conclusions of this study are:

(1) Differences have been found between the various candidate sites. However, no basis for eliminating any candidate site from consideration was found.

(2) Mitigating measures which would be of value in increasing the safety at each candidate site have been identified. The incorporation of these mitigating measures into preliminary and final design should be pursued.

It is recommended that mitigating measures be incorporated into any site selected as deemed necessary. Specifically, in any of the candidate sites located within the LWSC, the following recommendations regarding operational procedures are made:

(1) Accountability of skippers entering the LWSC in foul weather should be improved. To this end regulations should be issued for each vessel (taking into account the individual characteristics of the vessel) indicating under what foul weather conditions the skipper must obtain a mandatory radio briefing from PMC prior to undertaking the transit. At the same time PMC headquarters should provide the incoming skipper with any information on available alternate berthing either in a Puget Sound berth or within the western confines of the LWSC.

(2) An alternate berth capable of accomodating at least 1 large and 1 medium size NOAA vessel simultaneously should be made available in Puget Sound to ensure that transits of the LWSC would not have to be attempted under conditions of stress, in foul weather, or when traffic jams occur within the LWSC. Alternatively a dedicated alternative berth at Salmon Bay would be marginally acceptable although it does not provide the flexibility that a berth on Puget Sound would.

(3) Any NOAA vessel should transit the LWSC only when at least one senior officer has previous experience on the transit. This requirement should be made mandatory to ensure that a rapid turnover of personnel does not unintentionally leave the ship without an experienced senior officer aboard. In lieu of the use of experienced NOAA personnel, a Puget Sound Pilot could be used.

(4) Limitations on the speed of operation within the LWSC, which are now loosely stated, should be documented and guidelines should be drawn up, depending upon the individual ship characteristics, as to when it is permissible to exceed the suggested 4 knot speed.

APPENDIX 1

FILES REVIEWED (available through NOAA)

DESCRIPTION	DATE
IX-A-13 LTF Lake Washington Sailing Regattas	1/12/78
IX-A-13 U.W. to Schmidt - Dept. of Oceanography Ship Transits	1/16/78
IX-A-13 Powell to Frank - Sd. Pt. Ship Facility	9/8/77
IX-A-13 Carnahan to Frank - NOAA Vessels in Montlake Cut	10/4/77
IX-A-13 Seattle Pilot Contacts	6/23/77
IX-A-13 NOAA Ship Characteristics	7/12/77
IX-A-13 Log of NOAA Ship Transits	7/14/77
IX-A-13 Cost Estimate for Transiting	7/29/77
IX-A-13 Taylor to Schmidt - PMC Vessel Transits	6/8/77
IX-A-13 Taylor to Schmidt - PMC Vessel Transits	1/13/78
IX-A-4 COE to Schmidt - Comment Letters on Dredging	4/1/77
IX-A-13 Lippold to File - Passage of NOAA Vessels Through Lake Washington Ship Canal	4/8/77
IX-A-13 LTF University Bridge Openings	4/25/77

IX-A-4 Schmidt to COE - Response to Letters Commenting on Permit Application	4/26/77
IX-A-4 LTF - Response to Public Hearing of 6/14/77	7/8/77
IX-A-4 Poteat, COE to Erickson - Beginning of Series of Letters on Permit	6/2/77
IX-A-4 McCormick to COE - Discussion of 6/14/77 Meeting	6/21/77
IX-A-4 COE to Schmidt - Shoaling Rates and Controlling Widths of Ship Canal	6/24/77
IX-A-4 Wilkens to COE - Discussion of 6/14/77 Meeting	6/18/77
IX-A-4 McClelland to Times - Discussion of Permit Hearing	6/23/77
IX-A-4 Oceano. Comm. of Wash. - Discussion of Permit Hearing	6/20/77
IX-A-4 Bernson to COE - Statement in Lieu of Attend. Hearing	6/21/77
IX-A-4 Schmidt to COE - Comments Consolidated on Hearings	7/12/77
IX-A-4 Hawthorne Hills Community Club to COE - Favorable Comments	7/27/77
IX-A-13 Montlake Bridge Openings	8/1/77
IX-A-4 Schmidt to COE - Comments Regarding Permit Request	8/5/77
IX-A-13 LTF - Width of Lake Washington Ship Canal	8/16/77
IX-A-13 Gough to COE - Transit of NOAA Ships Through Lake Washington Ship Canal	9/14/77

IX-A-4 Schmidt to COE - Statement of Conformity to State and Local Regulations	8/17/77
IX-A-13 LTF - Tug and Barge Activities Through to Montlake Cut	8/17/77
IX-A-4 Univ. of Wash. to COE - Support of NOAA	8/19/77
IX-A-4 Laurelhurst Community Club to COE - Opposition to NOAA Ships	9/9/77
IX-A-4 Application for Dredging Permit	2/18/77
IX-A-4 News Release of Dredging Permit	9/28/77
Nickum & Spalding - Impact Study of Large NOAA Vessel Transit Through Lake Washington Ship Canal	9/1/77
Corps of Engineers - Environmental Assessment for Dredging Permit	9/28/77
Zabinski, USCG to Poteat, COE - Review of Navigational Safety Concerns for Dredging Permit	8/19/77
Poteat to Gough - Discussion of Potential Disadvantages of Bringing Ships into Lake Washington	9/28/77
Jarrett to File - Vessel Transits of Montlake Cut - Discussion with Captain Olsberg, Puget Sound Pilots	1/5/78
Jarrett to File - Vessel Transits of Montlake Cut - Discussion with Capt. Luther, Puget Sound Pilots	1/5/78
Jarrett to File - University of Washington Waterfront Activities	3/16/78
Jarrett to File - Montlake Bridge Openings and Traffic Flow Conditions	1/18/78
Jarrett to File - 2 Memos Concerning Commercial Traffic on Lake Washington	1/23 & 25/78

Miller to Speer - Lake Washington Ship Canal Traffic	11/14/77
Albrecht - Vessel Moorage Alternatives Study	9/75
Tippetts-Abbett-McCarthy-Stratton to NBBJ - Pier Siting Study	2/77
Oceano. Inst. of Wash. to Gough - EIS Navigational Study	2/23/78
Speer to Taylor - Large Vessel Transits into Lake Washington	12/2/77
Lippold to File - Passage of NOAA Vessels Through the Lake Washington Ship Canal	
PMC Directives Concerning Water Pollution	
Project Instructions for Lake Washington Ship Canal and Lake Washington Survey issued to NOAA Ship Davidson	1/24/78
Affidavits of Donald W. Thurning, COE; Cdr. Raymond Speer, NOAA; and Captain G. Fredrick Lindholm, Puget Sound Pilots	
Additional Information - Comparative Site Study for the Consolidation of NOAA Seattle Area Operations by Robert G. Albrecht, P.E.	6/74
AD14 Rockville, MD to Director PMC - NOAA Vessel Accidents in Seattle Area	4/28/78
Taylor to Schmidt - Vessel Mishaps	5/4/78
Taylor to Van Horn - NOAA Ships Transiting LWSC - 1977	5/4/78
EXBW-60 LTF - Powell to Frank - Sand Point Ship Facility	9/8/77
EXBW-40 LTF - Lippold to Axl, NOS - Sand Point Safe Vessel Traffic	8/15/75
Taylor to Powell - Status Report - Move to Sand Point	4/11/78
LTF - Carnahan to Director, NOS - PMC Facility Lake Union	5/9/75

Apell to Hess - PMEL at Sand Point	3/2/78
Sand Point Building Committee to Frank - Contingency Plan for NOAA's Seattle Consolidation	12/1/77
Hess to Carnahan - Draft EIS for Sand Point	11/12/74
LTF - Powell to Frank - Sand Point Ship Facility	9/8/77
LTF - ADFNx1 to Jarrett - UW Recreational Boat Activity	3/16/78
Speer to Director, PMC - Large Vessel Transits into Lake Washington	12/2/77
Gough to Poteat - Transit of NOAA Ships Through LWSC	9/14/77
Speer to Townsend - Calculated Stop Distances for Class I Vessels	9/1/77
IX-A-13 Schmidt to Lum, COE - Oil Spills at PMC	6/29/77
Zabinski to Spearman, COE - Recent NOAA Spills	7/27/77
Geren, Water Compliance & Permits Branch to Spearman, COE - Water Quality Impacts	8/17/77
AOF9 x 1 LTF, Stanke - Width of LWSC	8/19/77

APPENDIX 2

PERSONS AND ORGANIZATIONS CONTACTED

Lloyd E. Finney, Streets and Bridge Maintenance, City of Seattle.

Captain Gunnar Olsborg, Puget Sound Pilots Association.

Charles Rowland, Boating Safety and Regattas, U.S. Coast Guard, 13th District.

Captain P. H. Luther, Puget Sound Pilots Association.

Tom Kirsch, Waterfront Activities Center, University of Washington.

Rich Tomlinson, METRO Sewer District, Seattle.

Commander Jay Pounds, Marine Safety Division, U.S. Coast Guard, 13th District.

Captain Adam Zabinski, Marine Safety Division, U.S. Coast Guard, 13th District.

Carl Comnick, Operations Office, Bridge Maintenance, City of Seattle.

Wayne Gorton, Operations Office, Bridge Maintenance, City of Seattle.

Ray Vanderhof (Montlake Bridge Tender), Operations Office, Bridge Maintenance, City of Seattle.

Commander Walton, Aids to Navigation Division, U.S. Coast Guard, 13th District.

Gerry Keller, U.S. Army Corps of Engineers, Seattle.

Commander Harry Oberden, Boat Safety Division, 13th U.S. Coast Guard District.

Byron Esko and Art Ficken, Project Office, Corps of Engineers, Chittenden Locks.

Charles Keenan, Western Environmental Trade Association, Seattle, Washington.

American Bureau of Shipping, New York.

American Institute of Marine Underwriters, New York.

John O'Donnell, American Hull Insurance Syndicate, New York.

MAJOR CONTACTS AND POINTS OF INFORMATION WITHIN NOAA WERE:

Admiral Eugene Taylor, Pacific Marine Center.

Captain Charles Townsend, Pacific Marine Center.

Henry Shek, Pacific Marine Center.

James Watkins, Sand Point Project Office.

Howard Langeveld, Sand Point Project Office.

James Hilario, Sand Point Project Office.

Captain R.E. Williams, NOAA, Washington, D.C.

APPENDIX 3

MAJOR STANDARD REFERENCES

1. Waterborne Commerce of the United States, Calendar Year 1976, Part IV, Waterways and Harbors, Pacific Coast, Alaska and Hawaii. Corps of Engineers. For sale by District Engineer, U.S. Army District, San Francisco, 100 McAllister Street, San Francisco, California 94103 - $2.00.

   This annual publication lists for each district comparative statement of traffic for the previous years and the freight traffic for the current year by type of commodity and destination. It also list, for each major harbor, the number of trips by type and draft of vessel.

2. Port Series prepared by the Board of Engineers for Rivers and Harbors, for sale by Board of Engineers for Rivers and Harbors, Kingman Building, Fort Belvoir, Virginia 22060. Also for sale by Superintendent of Documents, U.S. Government Office, Washington, D.C. 20402.

   This valuable series of documents provides location and general description for each harbor, pertinent pictures, and overview or aerial photograph of the harbor, and a detailed description of each pier, wharf, and dock within the harbor, keyed to the map. Of particular value is the purpose for which pier, wharf, or dock is used.

   - The Ports of Tacoma, Greys Harbor, and Olympia, Washington, Port Series No. 35, revised 1975, priced $3.90.
   - Port of Seattle, Washington, Port Series No. 36, Revised 2975, priced $3.50.
   - Ports of Port Angeles, Port Townsend, Everett, Anacortes, and Bellingham, Washington, Port Series No. 37, revised 1976, priced $4.00.

3. United States Coast Pilot 7, Pacific Coast - California, Oregon, Washington, and Hawaii prepared by the National Oceanic and Atmospheric Administration, National Ocean Survey, U.S. Department of Commerce, available through marine supply stores.

4. Nautical Charts issued by the National Oceanic and Atmospheric Administration, National Ocean Survey, U.S. Department of Commerce, available through marine supply stores.

- Lake Washington Ship Canal and Lake Washington, Washington. Nautical Chart 18447, Edition 16, April 1978.

- Admiralty Inlet, Puget Sound, Nautical chart 18440, 11th Edition, 1977.

- These nautical charts and others similar on a larger scale, provide information on channel depth, access, etc. and are very useful in following discussions in the study.

5. Tidal currents, charts, National Ocean Survey, National Oceanic and Atmospheric Administration, Department of Commerce. Available through navigational supply stores.

   - Puget Sound, Northern Part, 3rd Edition, 1973.

   - Puget Sound, Southern Part, 3rd Edition, 1973.

APPENDIX 4

CHARACTERIZATION OF NOAA VESSELS LOCATED AT THE PACIFIC MARINE CENTER, LAKE UNION

Prepared by

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May 30, 1978

INTRODUCTION

The intent of this document is to review the vessel characteristics that pertain to navigational risk of the NOAA fleet presently home-ported at the Pacific Marine Center (PMC) and to compare those characteristics to standard U.S. commercial vessel practice.

The characteristics which will be examined are: power plants, bridge control, steering, system redundancy, navigational and communication equipment, and slow speed maneuverability.

CHARACTERISTICS OF NOAA VESSELS

In general, the NOAA fleet stationed at the Pacific Marine Center is composed of vessels that have good maneuvering characteristics compared to commercial vessels of equivalent size. Maneuvering, as used in this report, implies both the ability to vary the magnitude and direction of power application and the ability to vary vessel position and orientation. The nature of the mission of these vessels, oceanographic survey and research, requires that they have maneuvering and positioning capabilities far in excess of normal commercial practice. On-site inspection and plan review of these vessels confirms this notion.

A. Power Plants

Of the ten vessels under consideration, three have power plants that are the same as standard U.S. commercial vessel practice. These three vessels are the Class I ship, the SURVEYOR, and the two Class V vessels, the OREGON and the JOHN N. COBB. The SURVEYOR has steam turbine main propulsion and a single fixed blade propeller, which is standard for deep draft U.S. commercial vessels. Her maneuvering characteristics have been somewhat enhanced by the addition of a stern-mounted 200 H.P. Harbormaster system. This auxiliary propulsion unit is capable of being directed in a full 360° circle, providing thrust at the stern in any direction. This feature improves the maneuverability of this vessel to a point slightly in excess of standard commercial practice.

The two Class V vessels have geared Diesel engine power plants and single fixed pitch propellers. They are therefore identical to the overwhelming majority of commercial fishing vessels and tugboats of equivalent size operating in the Pacific Northwest.

The remaining seven vessels have features that result in maneuvering characteristics that are superior to the standard U.S. commercial practice. The two Class I sister ships, OCEANOGRAPHER and DISCOVERER, have Diesel electric main propulsion, with twin fixed bladed propellers. Diesel electric systems are usually provided only on vessels that require quick response and good maneuverability. These power plants are generally more

expensive than standard geared Diesel or steam turbine plants. Many of the Washington State ferries are provided with Diesel electric power plants to satisfy their requirements for quick response and maneuverability.

The three Class II vessels, sisters FAIRWEATHER and RAINIER, and the MILLER FREEMAN and the two Class III vessels, sisters McARTHUR and DAVIDSON, have geared Diesels and controllable pitch propellers. Controllable pitch propellers provide greater control of power and quicker response to changes in power than fixed pitch propellers. Consequently, these vessels have maneuvering characteristics in excess of standard commercial practice.

B. Bridge Control

Nine of these ten NOAA vessels have direct bridge control of their power plants, the exception being the SURVEYOR. This implies quicker response on these nine vessels, since the skipper can change powering without going through the normal shipboard practice of signaling from the bridge to the engine room through the engine telegraph with the engineer then responsible for adjusting the power controls at his control panel in the engine room. All the Class I and II vessels have thrusters for providing athwartship thrust including through hull, fixed bow thrusters on the OCEANOGRAPHER, DISCOVERER, FAIRWEATHER, and RAINIER, a stern mounted Harbormaster on the SURVEYOR, and a retractable bow thruster on the MILLER FREEMAN.

C. Steering

All ten vessels have standard commercial electro-hydraulic steering gears, with two independent pumps and motors each of which is capable of activating the rams to move the tillers and turn the rudders. In addition, mechanical backup is available, generally by rigging a block and tackle at the steering gear, or by hand-driven pumps to activate the hydraulic system at the steering gear. The JOHN N. COBB has a mechanical backup system on the bridge in the form of a wheel which produces a manual pumping action to activate the hydraulic steering system. The steering gear on these ships is equivalent to standard U.S. commercial practice.

D. System Redundancy

Six of the ten vessels have full redundancy of power plants. The OCEANOGRAPHER and DISCOVERER can employ any combination of their 4 Diesel-generator sets to power the 2 propulsion motors. Each motor is used to drive a propeller. Consequently, loss of a Diesel-generator set would not seriously affect power generation. Loss of a propulsion motor would result in the loss of one of the two propellers for power transmission. The FAIRWEATHER, RAINIER, McARTHUR and DAVIDSON each have 2 independent propulsion systems, including a Diesel engine, reduction gear set and shaft and propeller. For these four vessels, loss of any part of these systems would

result in loss of power from one propeller but would not affect the other propeller. Despite this redundancy, certain failures can result in total loss of power. Such total power plant failures have occurred on at least two of these six vessels but with no serious consequences.

The remaining four vessels have less redundancy in main propulsion. The SURVEYOR, while only single screw, has two boilers and two turbines and thus would be capable of some power generation despite the loss of a boiler or turbine. Problems in the drive train (gears, shaft and propeller) would result in loss of main engine power. This vessel does have a small stern-mounted Harbormaster unit, which is independent of the main propulsion system and which could provide power to limited maneuverability. The MILLER FREEMAN has a single Diesel and gear set and a single screw. Loss of a part of this system would result in the loss of main power. A retractable bow thruster, independent of the main power plant, would provide some maneuvering power. The OREGON and the JOHN N. COBB both have single Diesel engines, single reduction gear sets and single screws. They would be without maneuvering power should they lose any part of their main propulsion system.

E. Navigation and Communication Equipment

All ten vessels have navigation and communication equipment far in excess of standard U.S. commercial practice, in part as a result of their missions. All vessels have a minimum of two VHF/FM bridge-to-bridge transceivers (1 is required by Coast Guard regulations) and at least one high frequency radio-telephone transceiver. All vessels have two independent radar sets and at least two shallow water echo depth sonders, with the exception of the JOHN N. COBB which has one. For transitting the waters of the Lake Washington Ship Canal from Puget Sound to Lake Washington, the VHF/FM bridge-to-bridge transceivers, the shallow water echo depth sounders and the radar are probably the most important pieces of navigation and communication equipment.

F. Slow Speed Characteristics

There is very little data available with which to judge the turning and stopping characteristics of the vessels in the NOAA PMC fleet. New vessel sea trial data were available for six of the vessels. These data only provided full speed turning circle diameter and advance for four vessels and full speed crash stop distance for two vessels. These data show that these vessels, OCEANOGRAPHER, DISCOVERER, FAIRWEATHER, RAINIER, McARTHUR, and DAVIDSON would compare favorably with standard commercial vessels. Since these data do not permit accurate prediction of maneuvering characteristics at the slow speeds proposed for NOAA vessel operation in the Lake Washington Ship Canal (about 4 knots), NOAA will, in the near future, conduct comprehensive sea trials to determine slow speed characteristics for each vessel.

COMPARISON WITH COMMERCIAL VESSELS

Standard commercial practice for deep draft vessels (equivalent to NOAA Class I, II and III) would entail either steam turbine or geared diesel main propulsion driving a single propeller. A single rudder would also be standard. Generally, no side thrusters would be installed as part of standard commercial practice. Using this as a baseline for comparison, it is quite apparent that six of the eight larger NOAA vessels are superior to commercial practice, combining twin screw, twin rudder systems with superior Diesel-electric or controllable pitch propeller systems. This includes the OCEANOGRAPHER, DISCOVERER, FAIRWEATHER, RAINIER, McARTHUR, and DAVIDSON. Twin screws provide the greatest improvement over commercial practice for turning ability, and either Diesel-electric propulsion or controllable pitch propellers provide quicker engine response to commands. The MILLER FREEMAN has a single propeller and rudder, but has a controllable pitch propeller providing quicker engine response. This vessel additionally has a retractable bow thruster to aid turning ability at slow speeds. The SURVEYOR is superior to standard commercial practice only slightly in terms of turning ability due to the presence of the stern-mounted 360° thruster. Maneuverability is less critical for the Class V vessels due to their smaller size. These NOAA vessels, OREGON and JOHN N. COBB, are identical to standard commercial practice. Although all vessels can experience total power plant failure and/or complete loss of maneuvering capability, the larger NOAA vessels are better than standard commercial practice in this regard.

NOAA PMC FLEET VESSEL DATA

VESSEL	NUMBER	CLASS	LENGTH OVERALL	YEAR BUILT	DRAFT (MAX.)	CRUISING SPEED (KNOTS)	SHP
OCEANOGRAPHER	R101	I	303'	1966	19'9"	15	5000
DISCOVERER	R102	I	303'	1966	19'9"	15	5000
SURVEYOR	S132	I	292'	1960	19'5"	11	3200
FAIRWEATHER	S220	II	231'	1968	14'3"	13	2400
RAINIER	S221	II	231'	1968	14'3"	13	2400
MILLER FREEMAN	R223	II	215'	1967	19'11"	13	2150
McARTHUR	S330	III	175'	1966	12'2"	12	1600
DAVIDSON	S331	III	175'	1967	12'2"	12	1600
OREGON	R551	V	100'	1946	12'-0"	9.3	600
JOHN N. COBB	R552	V	94'	1950	14'-0"	9.3	325

NOAA PMC FLEET VESSEL DATA (Continued)

VESSEL	COMMUNICATION EQUIPMENT			NAVIGATION EQUIPMENT	
	EMERGENCY PORT. TRANSCEIVERS	RADIO AUTO ALARM	VHF EPIRB	RADAR	SATNAV
OCEANOGRAPHER	1-2 Watt	1	1	1-5 cm	2
DISCOVERER	1-2 Watt	1	1	1-10 cm "	2
SURVEYOR	1-2 Watt	1	1	"	2
FAIRWEATHER	1-2 Watt	1	1	2-5 cm	none
RAINIER	1-2 Watt	1	4	2-5 cm	none
MILLER FREEMAN	1-2 Watt	0	4	2-5 cm	1
McARTHUR	1-2 Watt	0	6	2-5 cm	none
DAVIDSON	1-2 Watt	0	6	2-5 cm	none
OREGON	1-2 Watt	0	1	2-5 cm	none
JOHN N. COBB	1 - Hand Power	0	4	2-5 cm	none

NOAA PMC FLEET VESSEL DATA (continued)

VESSEL	FUEL TYPE	FUEL CAPACITY (Gal.)	FUEL MAX. CREDIBLE SPILL (Gal.)	COMMUNICATION EQUIPMENT VHF/FM BRIDGE TO BRIDGE TRANSC.	COMMUNICATION EQUIPMENT HF RADIO-TELEPHONE TRANSC.	COMMUNICATION EQUIPMENT MF SAR TRANSC.
OCEANOGRAPHER	#2 Diesel	328,455	37,416	2 - 25 Watt	2-1 Kw, 1-150 W	1-40 W 1-500W
DISCOVERER	#2 Diesel	328,455	37,416	2 - 25 Watt	2-1 Kw	"
SURVEYOR	NSFO	265,000	25,242	2 - 25 Watt	2-1 Kw, 1-150 W	1-40 W 1-500 W
FAIRWEATHER	#2 Diesel	114,698	11,055	3 - 25 Watt	1-1 Kw, 2-150 W	"
RAINIER	#2 Diesel	114,698	11,055	6-25 Watt	1-1 Kw, 1-150 W	1-40 W 1-500 W
MILLER FREEMAN	#2 Diesel	151,570	23,152	2-25 Watt	2-1 Kw, 1-150 W	None
McARTHUR	#2 Diesel	64,582	12,302	2-25 Watt	2-1 Kw, 1-150 W	None
DAVIDSON	#2 Diesel	64,582	12,302	2-25 Watt	2-1 Kw, 1-150 W	None
OREGON	#2 Diesel	16,600	7,600	2-25 Watt	2-150 W	None
JOHN N. COBB	#1 Diesel	7,800	5,600	2-25 Watt	2-100 W	1-CB

NOAA PMC FLEET VESSEL DATA (Continued)

NAVIGATION EQUIPMENT

VESSEL	LORAN A/C	LORAN C	OMEGA	RDF	GYRO COMPASS	LINE OF SIGHT POSITIONING	MED. RANGE POSITIONING
OCEANOGRAPHER	2	2	1	1	1	0	0
DISCOVERER	2	2	0	1	1	0	0
SURVEYOR	2	2	0	1	1	0	0
FAIRWEATHER	2	2	0	0	1	3	4
RAINIER	2	2	0	0	1	3	3
MILLER FREEMAN	1	2	0	0	1	0	0
McARTHUR	1	1	0	0	1	0	0
DAVIDSON	1	1	0	0	1	3	3
OREGON	2	1	0	0	0	0	0
JOHN N. COBB	2	1	0	0	0	0	0

NOAA PMC FLEET VESSEL DATA (Continued)

VESSEL	Fathometer		Sea Trial Maneuvering Data		
	Shallow Water Echo Sounder	Deep Water Echo Sounder	Full Speed Turning Diameter	Advance	Full Speed Crash Stop Distance
OCEANOGRAPHER	2-21 KHz	2-3.5/12 KHz	820'	1035'	425'
DISCOVERER	2-21 KHz	3-12 KHz	820'	1035'	425'
SURVEYOR	1-100 KHz 1-21 KHz	4-12 KHz	Unknown	Unknown	Unknown
FAIRWEATHER	1-100 KHz 1-21 KHz	2-12 KHz	495'	528'	Unknown
RAINIER	1-100 KHz 1-21 KHz	2-12 KHz	495'	528'	Unknown
MILLER FREEMAN	2-100 KHz 1-50 KHz	2-12 KHz	Unknown	Unknown	Unknown
McARTHUR	2-21 KHz	1-12 KHz	428'	463'	Unknown
DAVIDSON	1-21 KHz 1-100 KHz	1-12 KHz	428'	463'	Unknown
OREGON	1-100 KHz 1-25 KHz	0	Unknown	Unknown	Unknown
JOHN N. COBB	1-100 KHz 1-38 KHz	0	Unknown	Unknown	Unknown

NOAA PMC FLEET VESSEL DATA (continued)

VESSEL	PROPULSION TYPE	PROPULSION REDUNDANCY	PROPELLERS TYPE	NO.	NO. BLADES	DIAMETER
OCEANOGRAPHER	Diesel Electric	4 Diesels, 4 gens. 2 propulsion motors	Fixed Pitch	2	4	12'
DISCOVERER	Diesel Electric	interconnected	Fixed Pitch	2	4	12'
SURVEYOR	Steam Turbine	2 boilers, 2 turbs. 1 set reduct. gear	Fixed Pitch	1	4	13'
FAIRWEATHER	Geared Diesel	2 Diesels, 2 sets reduction gear	Control. Pitch	2	3	8'-6-3/8"
RAINIER	Geared Diesel	no interconnect	Control. Pitch	2	3	8'-6-3/8"
MILLER FREEMAN	Geared Diesel	1 Diesel, 1 set reduction gear	Control. Pitch	1	3	10'-2"
McARTHUR	Geared Diesel	2 Diesels, 2 sets reduction gear	Control. Pitch	2	3	6'-9-1/2"
DAVIDSON	Geared Diesel	no interconnect	Control. Pitch	2	3	6'-9-1/2"
OREGON	Geared Diesel	1 Diesel, 1 set	Fixed Pitch	1	3	5'-8"
JOHN N. COBB	Geared Diesel	1 Diesel, 1 set reduction gear	Fixed Pitch	1	3	5'

NOAA PMC FLEET VESSEL DATA (Continued)

VESSEL	MAIN ENGINE CONTROLS	STEERING GEAR			THRUSTERS AND AUXILIARY POWER
		TYPE	NO. PUMPS	MANUAL BACKUP	
OCEANOGRAPHER	Direct bridge control	Electro-hydraulic	2	at steering gear	Through hull bow thruster-400 H.P.
DISCOVERER	Direct bridge control	"	2	" "	" "
SURVEYOR	Engine room control	"	2	" "	Stern mounted Harbor-master-200 H.P.
FAIRWEATHER	Direct bridge control	"	2	" "	Through hull bow thruster-200 H.P.
RAINIER	Direct bridge control	"	2	" "	" "
MILLER FREEMAN	Direct bridge control	"	2	" "	Retractable bow thruster-400 H.P.
McARTHUR	Direct bridge control	"	2	" "	None
DAVIDSON	Direct bridge control	"	2	" "	None
OREGON	Direct bridge control	"	1	at bridge	None
JOHN N. COBB	Direct bridge control	"	2	at bridge	None

NOAA PMC FLEET - VESSEL FIRE DETECTION AND SUPPRESSION

	DETECTION		SUPPRESSION		
VESSEL	SMOKE	HEAT	TYPE	SPACE	FIRE DOORS
OCEANOGRAPHER	Yes	Yes	CO_2, Foam	Selected Spaces	Yes
DISCOVERER	Yes	Yes	CO_2, Foam	" "	"
SURVEYOR	No	Yes	CO_2, Steam smothering + foam	" "	"
FAIRWEATHER	Yes	Yes	CO_2, Foam	" "	"
RAINIER	Yes	Yes	CO_2, Foam	" "	"
MILLER FREEMAN	To be installed 1978-79		CO_2, Foam	" "	"
McARTHUR	No	Yes	CO_2, Foam	" "	"
DAVIDSON	No	Yes	CO_2, Foam	" "	"
OREGON	No	No	CO_2	Engine Room Only	No
JOHN N. COBB	No	No	CO_2	" " "	"

NOTE: All vessels are equipped with portable fire extinguishers and saltwater fire-fighting systems.

APPENDIX 5

CRITERIA FOR CALCULATION OF LOCATIONAL RISKS IN THE LWSC

APPENOIX 5

CRITERIA FOR CALCULATION OF LOCATIONAL RISKS IN THE LWSC

LOCATION	MITIGATING MEASURE PACKAGE	QUARTER*	MEASURE	TYPE OF RISK: COLLISION COMMERCIAL N	O	L	P	COLLISION RECREATIONAL N	O	L	P	RAMMING BRIDGE N	O	L	P	RAMMING CHANNEL N	O	L	P	GROUNDING N	O	L	P	WAKE DAMAGE TO SMALL CRAFT N	O	L	P	SUBTOTAL N+	O+	L+	P	LOCATIONAL RISK
Shilshole Bay	I, II, III	3	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	b	-	a	-	-	a	-	-					
			Frequency	x	x	x	-	y	y	y	-	-	-	-	-	-	-	-	-	x	-	x	-	-	x	-	-					
			Value	4	4	2	-	3	7	5	-	-	-	-	-	-	-	-	-	4	-	2	-	-	2	-	-	11	13	9	-	33
	I, II, III	1	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	b	-	a	-	-	a	-	-					
			Frequency	x	x	x	-	y	y	y	-	-	-	-	-	-	-	-	-	b	-	a	-	-	w	-	-					
			Value	4	4	2	-	1	5	4	-	-	-	-	-	-	-	-	-	4	-	3	-	-	1	-	-	9	10	8	-	27
BNRR Bridge	I	3 & 1	Magnitude	-	-	-	-	-	-	-	-	c	-	b	c	-	-	-	-	-	-	-	-	-	-	-	-					
			Frequency	-	-	-	-	-	-	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-					
			Value	-	-	-	-	-	-	-	-	6	-	4	6	-	-	-	-	-	-	-	-	-	-	-	-	6	-	4	6	I6
	II, III	3 & 1	Magnitude	-	-	-	-	-	-	-	-	b	-	a	b	-	-	-	-	-	-	-	-	-	-	-	-					
			Frequency	-	-	-	-	-	-	-	-	2	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-					
			Value	-	-	-	-	-	-	-	-	4	-	2	4	-	-	-	-	-	-	-	-	-	-	-	-	4	-	2	4	10
Chittenden Locks	I, II, III	3	Magnitude	a	b	-	-	a	b	b	-	-	-	-	-	b	-	-	a	-	-	-	-	-	-	-	-					
			Frequency	x	x	-	-	x	x	w	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-					
			Value	2	4	-	-	2	4	3	-	-	-	-	-	4	-	-	2	-	-	-	-	-	-	-	-	8	8	3	2	21
		1	Magnitude	a	b	-	-	a	b	a	-	-	-	-	-	b	-	-	b	-	-	-	-	-	-	-	-					
			Frequency	x	x	-	-	w	w	w	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-					
			Value	2	4	-	-	1	3	1	-	-	-	-	-	3	-	-	3	-	-	-	-	-	-	-	-	6	7	1	3	I7
Salmon Bay	I, II, III	3	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	a	-	-	-	-	a	-	-					
			Frequency	y	y	y	-	x	x	x	-	-	-	-	-	-	-	-	-	y	-	-	-	-	x	-	-					
			Value	5	5	3	-	2	6	4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	2	-	-	10	13	7	-	30
	I, II, III	1	Magnitude	b	b	a	-	a	b	b	-	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	-					
			Frequency	y	y	y	-	w	w	w	-	-	-	-	-	-	-	-	-	y	-	-	-	-	-	-	-					
			Value	5	5	3	-	1	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	9	8	6	-	23
Ballard Bridge	I	3 & 1	Magnitude	-	-	-	-	-	-	-	-	c	-	b	c	-	-	-	-	-	-	-	-	-	-	-	-					
			Frequency	-	-	-	-	-	-	-	-	w	-	w	w	-	-	-	-	-	-	-	-	-	-	-	-					
			Value	-	-	-	-	-	-	-	-	5	-	3	5	-	-	-	-	-	-	-	-	-	-	-	-	5	-	3	5	I3
	II & III	3 & 1	Magnitude	-	-	-	-	-	-	-	-	b	-	-	b	-	-	-	-	-	-	-	-	-	-	-	-					
			Frequency	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-					
			Value	-	-	-	-	-	-	-	-	4	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	4	-	1	4	8
Fremont Cut	I, II, III	3	Magnitude	b	a	a	-	a	c	b	-	-	-	-	-	-	-	-	-	a	-	-	-	-	a	b	a					
			Frequency	y	y	y	-	x	x	x	-	-	-	-	-	-	-	-	-	y	-	-	-	-	y	x	x					
			Value	5	3	3	-	2	6	6	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3	4	2	10	I2	I3	2	37
		1	Magnitude	b	a	a	-	a	c	b	-	-	-	-	-	-	-	-	-	a	-	-	-	-	a	a	a					
			Frequency	y	y	y	-	w	w	w	-	-	-	-	-	-	-	-	-	y	-	-	-	-	w	w	x					
			Value	5	3	3	-	1	5	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1	I	2	9	9	7	2	27

CRITERIA FOR CALCULATION OF LOCATIONAL RISKS IN THE LWSC (Cont.)

LOCATION	MITIGATING MEASURE PACKAGE	QUARTER*	MEASURE	TYPE OF RISK: COLLISION COMMERCIAL N	O	L	P	COLLISION RECREATIONAL N	O	L	P	RAMMING BRIDGE N	O	L	P	RAMMING CHANNEL N	O	L	P	GROUNDING N	O	L	P	WAKE DAMAGE TO SMALL CRAFT N	O	L	P	SUBTOTAL N+	O+	L+	P	LOCATIONAL RISK
Fremont Bridge (1) due to lower clearance	I	3 & 1	Magnitude	-	-	-	-	-	-	-	-	d(1)	c	d		-	-	-	-	-	-	-	-	-	-	-	-					
			Frequency	-	-	-	-	-	-	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-					
			Value	-	-	-	-	-	-	-	-	8	-	6	8	-	-	-	-	-	-	-	-	-	-	-	-	8	-	6	8	22
	II & III	3 & 2	Magnitude	-	-	-	-	-	-	-	-	c	-	b	c	-	-	-	-	-	-	-	-	-	-	-	-					
			Frequency	-	-	-	-	-	-	-	-	w	-	w	w	-	-	-	-	-	-	-	-	-	-	-	-					
			Value	-	-	-	-	-	-	-	-	5	-	3	5	-	-	-	-	-	-	-	-	-	-	-	-	5	-	3	5	13
Lake Union	I, II, III	3	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	a					
			Frequncy	y	y	y	-	y	y	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x					
			Value	5	5	3	-	3	7	4	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	10	12	7	2	31
		1	Magnitude	b	b	a	-	a	b	b	-	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	a					
			Frequency	y	y	y	-	x	w	w	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x					
			Value	5	5	3	-	2	3	3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	9	8	6	2	25
University Bridge	I	3 & 1	Magnitude	b	b	-	-	a	b	-	-	c	-	b	c	b	-	a	b	-	-	-	-	-	a	-	a					
			Frequency	w	w	-	-	w	w	-	-	x	-	x	x	w	-	w	w	-	-	-	-	-	x	-	x					
			Value	3	3	-	-	1	3	-	-	6	-	4	6	3	-	1	3	-	-	-	-	-	2	-	2	13	8	5	11	37
	II & III	3 & 1	Magnitude	a	a	-	-	-	b	-	-	b	-	a	b	a	-	-	a	-	-	-	-	-	a	-	a					
			Frequency	w	w	-	-	-	w	-	-	x	-	x	x	w	-	-	w	-	-	-	-	-	w	-	w					
			Value	1	1	-	-	-	3	-	-	4	-	2	4	1	-	-	1	-	-	-	-	-	1	-	1	6	5	2	6	19
Portage Bay Reach	I & II	3	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	b	-	-	-	-	a	-	a					
			Frequency	w	w	w	-	x	x	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	x					
			Value	3	3	1	-	2	6	4	-	-	-	-	-	-	-	-	-	4	-	-	-	-	2	-	2	9	11	5	2	27
		1	Magnitude	b	b	a	-	a	b	a	-	-	-	-	-	-	-	-	-	b	-	-	-	-	-	-	a					
			Frequency	w	w	w	-	w	w	w	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x					
			Value	3	3	1	-	1	3	1	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	2	8	6	2	2	18
	III	3	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	a	-	-	-	-	a	-	a					
			Frequency	w	w	w	-	x	x	x	-	-	-	-	-	-	-	-	-	w	-	-	-	-	w	-	w					
			Value	3	3	1	-	2	6	4	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	1	6	10	5	1	22
		1	Magnitude	b	b	a	-	a	b	a	-	-	-	-	-	-	-	-	-	a	-	-	-	-	-	-	a					
			Frequency	w	w	w	-	w	w	w	-	-	-	-	-	-	-	-	-	w	-	-	-	-	-	-	w					
			Value	3	3	1	-	1	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	5	6	2	1	14
Portage Cut	I & II	3	Magnitude	b	b	b	-	a	d	d	-	-	-	-	-	L	-	-	b	-	-	-	-	-	b	b	-					
			Frequency	x	x	x	-	y	y	y	-	-	-	-	-	y	-	-	y	-	-	-	-	-	y	y	-					
			Value	4	4	4	-	3	9	9	-	-	-	-	-	7	-	-	5	-	-	-	-	-	5	5	-	14	18	18	5	55

CRITERIA FOR CALCULATION OF LOCATIONAL RISKS IN THE LWSC (Cont.)

LOCATION	MITIGATING MEASURE PACKAGE	QUARTER*	MEASURE	TYPE OF RISK: COLLISION – COMMERCIAL N	COMMERCIAL O	COMMERCIAL L	COMMERCIAL P	COLLISION – RECREATIONAL N	RECREATIONAL O	RECREATIONAL L	RECREATIONAL P	RAMMING – BRIDGE N	BRIDGE O	BRIDGE L	BRIDGE P	RAMMING – CHANNEL N	CHANNEL O	CHANNEL L	CHANNEL P	GROUNDING N	GROUNDING O	GROUNDING L	GROUNDING P	WAKE DAMAGE TO SMALL CRAFT N	CRAFT O	CRAFT L	CRAFT P	SUBTOTAL N+	SUBTOTAL O+	SUBTOTAL L+P	SUBTOTAL P	LOCATIONAL RISK
Portage Cut (Cont.)	I & II	1	Magnitude	b	b	b	-	a	c	b	-	-	-	-	-	c	-	-	b	-	-	-	-	-	b	-	-					
			Frequency	x	x	x	-	x	x	x	-	-	-	-	-	x	-	-	x	-	-	-	-	-	x	-	-					
			Value	4	4	4	-	2	6	4	-	-	-	-	-	6	-	-	4	-	-	-	-	-	4	-	-	12	14	8	4	38
	III	3	Magnitude	a	a	a	-	a	c	c	-	-	-	-	-	L	-	-	b	-	-	-	-	-	a	a	-					
			Frequency	x	x	x	-	x	x	x	-	-	-	-	-	x	-	-	x	-	-	-	-	-	w	w	-					
			Value	2	2	2	-	2	6	6	-	-	-	-	-	6	-	-	4	-	-	-	-	-	2	2	-	10	10	10	4	34
		1	Magnitude	a	a	-	-	a	b	b	-	-	-	-	-	L	-	-	b	-	-	-	-	-	a	a	-					
			Frequency	x	x	-	-	x	x	x	-	-	-	-	-	x	-	-	x	-	-	-	-	-	w	w	-					
			Value	2	2	-	-	2	4	4	-	-	-	-	-	6	-	-	4	-	-	-	-	-	1	1	-	10	7	5	4	26
Montlake Bridge	I	3 & 1	Magnitude	-	-	-	-	-	-	-	-	c	-	b	c	-	-	-	-	-	-	-	-	-	-	-	-					
			Frequency	-	-	-	-	-	-	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-					
			Value	-	-	-	-	-	-	-	-	6	-	4	6	-	-	-	-	-	-	-	-	-	-	-	-	6	-	4	6	16
	II & III	3 & 1	Magnitude	-	-	-	-	-	-	-	-	b	-	a	b	-	-	-	-	-	-	-	-	-	-	-	-					
			Frequency	-	-	-	-	-	-	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-					
			Value	-	-	-	-	-	-	-	-	4	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	4	-	1	4	9
Union Bay Reach	I & II	3	Magnitude	b	b	b	-	a	c	c	-	-	-	-	-	-	-	-	-	c	-	a	-	-	b	-	-					
			Frequency	y	y	y	-	y	y	y	-	-	-	-	-	-	-	-	-	y	-	y	-	-	y	-	-					
			Value	5	5	3	-	3	7	7	-	-	-	-	-	-	-	-	-	7	-	3	-	-	5	-	-	15	17	13	-	45
		1	Magnitude	b	b	b	-	a	b	a	-	-	-	-	-	-	-	-	-	c	-	a	-	-	a	-	-					
			Frequency	y	y	y	-	x	x	x	-	-	-	-	-	-	-	-	-	x	-	x	-	-	x	-	-					
			Value	5	5	3	-	2	4	2	-	-	-	-	-	-	-	-	-	6	-	2	-	-	2	-	-	13	11	7	-	31
	III	3	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	b	-	a	-	-	b	-	-					
			Frequency	x	x	x	-	x	x	x	-	-	-	-	-	-	-	-	-	w	-	w	-	-	w	-	-					
			Value	4	4	2	-	2	6	4	-	-	-	-	-	-	-	-	-	3	-	1	-	-	4	-	-	9	14	7	-	30
		1	Magnitude	b	b	a	-	a	b	a	-	-	-	-	-	-	-	-	-	b	-	a	-	-	a	-	-					
			Frequency	x	x	x	-	x	x	x	-	-	-	-	-	-	-	-	-	w	-	w	-	-	w	-	-					
			Value	4	4	2	-	2	4	2	-	-	-	-	-	-	-	-	-	3	-	1	-	-	1	-	-	9	9	5	-	23
Sand Point	I, II, III	3	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	b	-	-	-	-	a	-	a					
			Frequency	x	x	x	-	x	x	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	x					
			Value	4	4	2	-	2	6	4	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	2	10	12	6	2	30
		1	Magnitude	b	b	a	-	a	b	b	-	-	-	-	-	-	-	-	-	b	-	-	-	-	-	-	a					
			Frequency	x	x	x	-	x	x	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x					
			Value	4	4	2	-	1	3	3	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	2	9	7	5	2	23

CRITERIA FOR CALCULATION OF LOCATIONAL RISKS IN THE LWSC (Cont.)

LOCATION	MITIGATING MEASURE PACKAGE	QUARTER*	MEASURE	TYPE OF RISK: COLLISION – COMMERCIAL N	O	L	P	COLLISION – RECREATIONAL N	O	L	P	RAMMING – BRIDGE N	O	L	P	RAMMING – CHANNEL N	O	L	P	GROUNDING N	O	L	P	WAKE DAMAGE TO SMALL CRAFT N	O	L	P	SUBTOTAL N+	O+	L+F		LOCATIONAL RISK
Kenmore	I, II, III	3	Magnitude	b	b	a	-	a	c	b	-	-	-	-	-	-	-	-	-	b	-	-	-	-	a	-	a					
			Frequency	x	x	x	-	y	y	y	-	-	-	-	-	-	-	-	-	x	-	-	-	-	y	-	y					
			Value	4	4	2	-	3	7	5	-	-	-	-	-	-	-	-	-	4	-	-	-	-	3	-	3	11	14	7	3	35
		1	Magnitude	b	b	a	-	a	b	a	-	-	-	-	-	-	-	-	-	b	-	-	-	-	a	-	a					
			Frequency	x	x	x	-	x	x	x	-	-	-	-	-	-	-	-	-	y	-	-	-	-	w	-	x					
			Value	4	4	2	-	2	4	2	-	-	-	-	-	-	-	-	-	5	-	-	-	-	1	-	2	11	9	4	2	26

KEY:

Impact On:

N = NOAA Vessels
O = Other Vessels
L = Life and Limb
P = Other Property

Quarter:

3 = July, August, September
1 = January, February, March

APPENDIX 6

NOAA VESSEL MISHAPS: 1959 - PRESENT

1. 1959 - HODGSON (No longer in service)

   On docking, ship struck PMC pier resulting in damaged bull rail and broken light standard. Approximately $1,000 damage to pier and no damage to ship.

2. 1960 - SURVEYOR

   Ship struck fender pier of the Great Northern Railroad Bridge and damaged piling and bull rail sections. Approximately $5,000 damage to the pier and no damage to this ship.

3. 1960 - PATHFINDER (No longer in service)

   Ship struck the Great Northern Railroad Bridge causing damage to yardarm and no damage to bridge.

4. 1961 - SURVEYOR

   When the ship was departing the old PMC base, her anchor locked on the guide wires holding the flag pole of the U.S. Naval Reserve Station. No damage was sustained.

5. 24 July 1973 - OCEANOGRAPHER

   Ship damaged a fishing net in the Strait of Juan de Fuca. Claim paid in the amount of $489.82.

6. 21 November 1973 - OCEANOGRAPHER

   Ship touched bottom between locks and Lake Union. Only damage was a two foot by four foot scrape on hull.

7. 15 January 1974 - FAIRWEATHER

   When backing from PMC berth, ship struck Lake Union Shipyard pier, stern of ship Surveyor and PMC Pier A. Damages were to Lake Union pier - $1,010; to ship Surveyor - bent rail nicked harbormaster blade (no estimate of damages).

8. July 175 - OCEANOGRAPHER

Alleged wake damage to two pilings at Wheeler Yacht Sales when proceeding west bound through the ship canal. Claim denied.

9. 4 December 1975 - MILLER FREEMAN

During mooring of the MILLER FREEMAN, ship struck the PMC dock and damaged six pilings. Cost to replace pilings was $1,750.

10. 10 March 1975 - McARTHUR

When berthing at Standard Oil's pier at Point Wells, ship damaged two fender piles. $819.00 damage to pier and no damage to ship.

11. 14 December 1976 - RAINIER

When antenna struck underside of Burlington Northern Railroad Bridge. Approximately $1,000 damage to antenna; no damage to bridge.

12. 15 November 1976 - SURVEYOR

Starboard yardarm of foremast hit underside of Burlington Northern Railroad Bridge. Approximately $2,500 damage to the yardarm and no damage to bridge.

13. 27 July 1977 - FAIRWEATHER

Ship's wake caused damage to Alaska Cargo Line, Inc. barge ramp system. Damages $406.02.

14. September 1977 - SURVEYOR

Ship's wake allegedly caused the bows of two vessels tied up at the Western Pioneer Lines pier to come in contact. Apparently no damage was done and no claim was filed.

TABLE 20 CATEGORIZATION OF NOAA MISHAPS

	Degree of Damage				Recipient of Damage			
Mishap Number	None or Minor	Significant	Serious	Major	NOAA Ships or Piers	Other Vessels	Persons	Other Property
1		X			X			
2			X					X
3		X			X			
4	X							
5		X				X		X
6	X				X			
7		X			X			
8	X							X
9		X			X			
10		X			X			
11		X			X			
12		X			X			
13		X						X
14	X							X

Degree of Damage Criteria

None or Minor: scratches only
Significant: requires repair but causes no operational delays
Serious: may stop operations until inspected or repaired
Major: temporary or permanent disability of ship(s) or facilities

APPENDIX B

WATER QUALITY AND AQUATIC BIOLOGY

TABLE B-1

STATE OF WASHINGTON WATER QUALITY CLASSIFICATIONS
IMPORTANT WATER QUALITY STANDARDS FOR FRESHWATER

Parameter	AA (Extraordinary)	A (Excellent)	B (Good)	C (Fair)	Lake Class
Fecal Coliform Organisms (#/100 ml)	median ≤50 and <10% exceeding 100	median <100 and ≤10% exceeding 200	median <200 and ≤10% over 400	same as B	median <50 and <10% over 100
Dissolved Oxygen (mg/l)	>9.5	>8.0	>6.5 or 70% saturation	>4.0 or 50% saturation	No measureable decrease from natural conditions
Temperature (C°)	16°C and t≤23/T+5°	18°C and t≤28/(T-7)	21°C and t≤34/(T+9)	24°C and t≤39/T+11)	No measurable change from natural conditions
ph (Standard Units) (Range)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.0	No measurable change from natural conditions
Turbidity Increase	≤5 NTU or 10% increase	≤5 NTU or 10% increase	≤10% NTU or 20% increase	≤10 NTU or 10% increase	≤5 NTU

TABLE B-1 (cont.)

STATE WATER QUALITY STANDARDS FOR MARINE WATER

Parameter	AA (Extraordinary)	A (Excellent)	B (Good)	C (Fair)
Fecal Coliform #/100 ml	median <14 <10% samples exceeding 43	Same as AA	median <100 <10% samples exceeding 200	median <200 <10% samples exceeding 400
Dissolved Oxygen mg/l	>7.5	>6.5	>5.0 or 70% saturation	>4.0 or 50% saturation
Temperature °C	<13	<16	<19	<22
pH	7.0-8.5	Same as AA	Same as AA	6.5-9.0

TABLE B-2

Mean of Water Quality Data for Six Stations in the East Waterway[1]

Site #	PSS005	PSS006	PSS007	PSS008	PSS009	PSS010
Temperature C	11.5[2] (18.2)	11.0 (17.9)	11.1 (18.1)	11.1 (18.2)	11.4 (18.6)	11.3 (19.0)
Turbidity JTU	4.5 (20.)	4.7 (30.)	5.2 (20.)	5.8 (25.)	7. (85.)	6.3 (20.)
Salinity PPT	25 (10-33)	25 (2-33)	25 (13-33)	25 (14-33)	25 (13-32)	25 (13.5-35)
D.O. mg/l	7.8 (3.8)	6.9 (3.0)	6.6 (2.1)	6.6 (1.2)	6.7 (0.7)	5.9 (0.1)
Total Coliforms #/100ml	2300 (16000)	4000 (25000)	53000 (41000)	5400 (44000)	10000 (78000)	43000 (17200)

1) For sample site locations, see Figure 2-2.

2) "Worst Case" values are shown in parentheses except for salinity where the range is included.

Source: EPA STORET Data Summary - all depths averaged

TABLE B-3

Mean of Sediment Analyses in the East Waterway, Everett[1]

Total Solids (mg/l)	33.5
Initial Dissolved Oxygen Demand (mg/l) (1:300 dilution)	4.2
% Dry Basis	
Chemical Oxygen Demand	40
Volatile Solids	25
Oil and Grease	0.42
Sulfide	0.25
Elutriate Tests - ppm above background water	
Arsenic	Undetectable
Zinc	0.013
Cadmium	Undetectable
Nickel	0.004
Lead	Undetectable
Copper	0.004
Chromium	Undetectable

Source: Army Corps of Engineers, Seattle District
May, 1976

1) For sample site locations see Figure 2-2.

TABLE B-4

Water Qualty Summary for

Site Off the Town of Mukilteo

Parameter	Mean	Range
Temperature (°C)	10.9	6-17
Turbidity (JTU)	2.7	0-15
Salinity (PPT)	26	13-33
D.O. (mg/l)	8.9	4.5-15.5
Sulfite Waste Liquor PBI	13	0-36
Total Coliforms (#/100ml)	137	0-1000

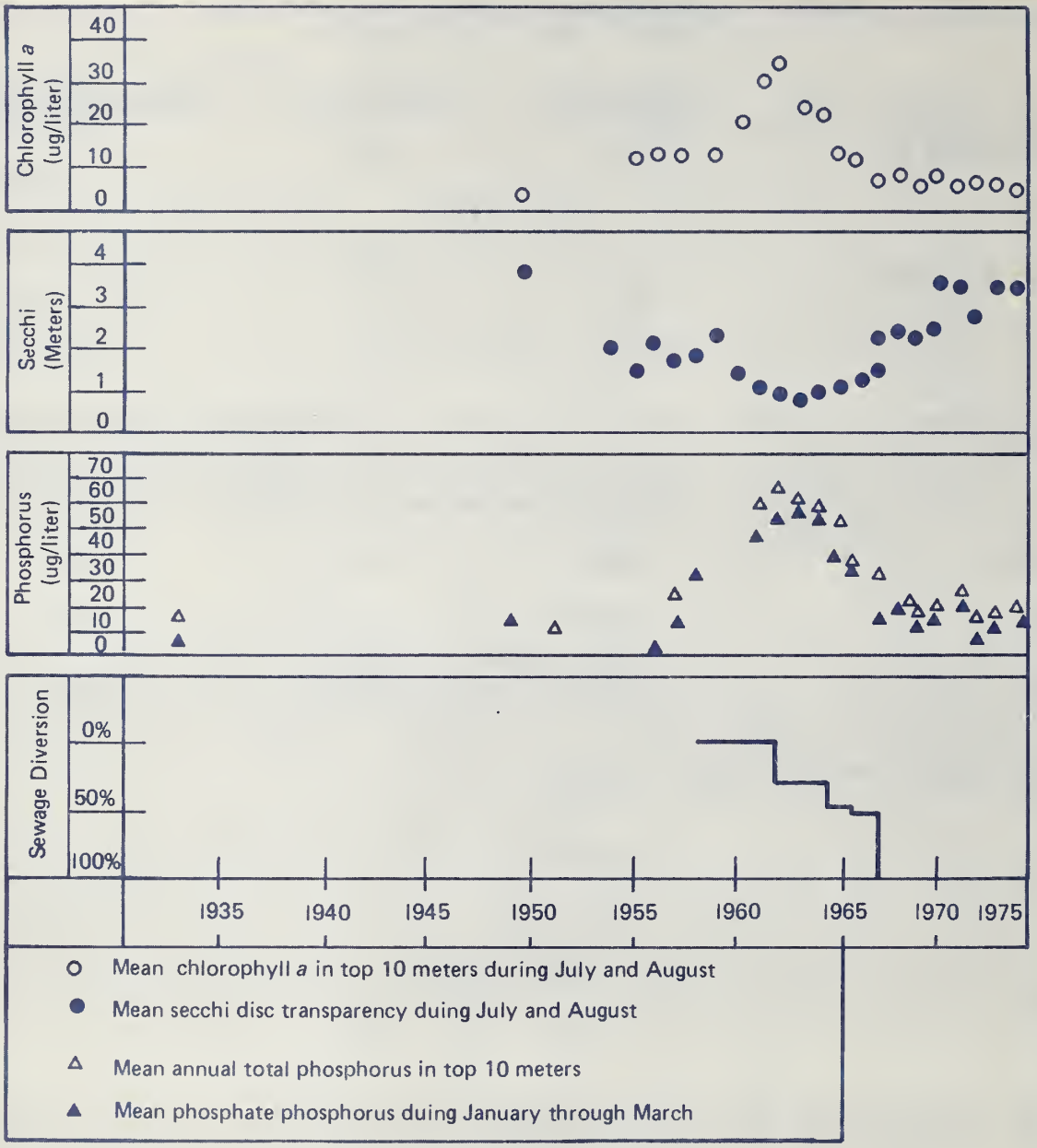
Source: EPA STORET water quality data - 1967 to 1970 - all depths averaged

TABLE B-5

Sediment Analyses at the South Mukilteo Site[1]

	Location 1	Location 2	Background Water
Total Solids %	79.7	78.8	
	% Dry Basis		
Volatile Solids	1.0	1.0	
COD	0.9	1.0	
Oil and Grease	0.06	0.03	
Sulfide	--	--	
	mg/l Elutriate Test		
Mercury	0.001	0.003	<0.001
Lead	0.005	0.005	0.005
Copper	0.031	<0.001	<0.001

1) See Figure 2-4 for sample locations.

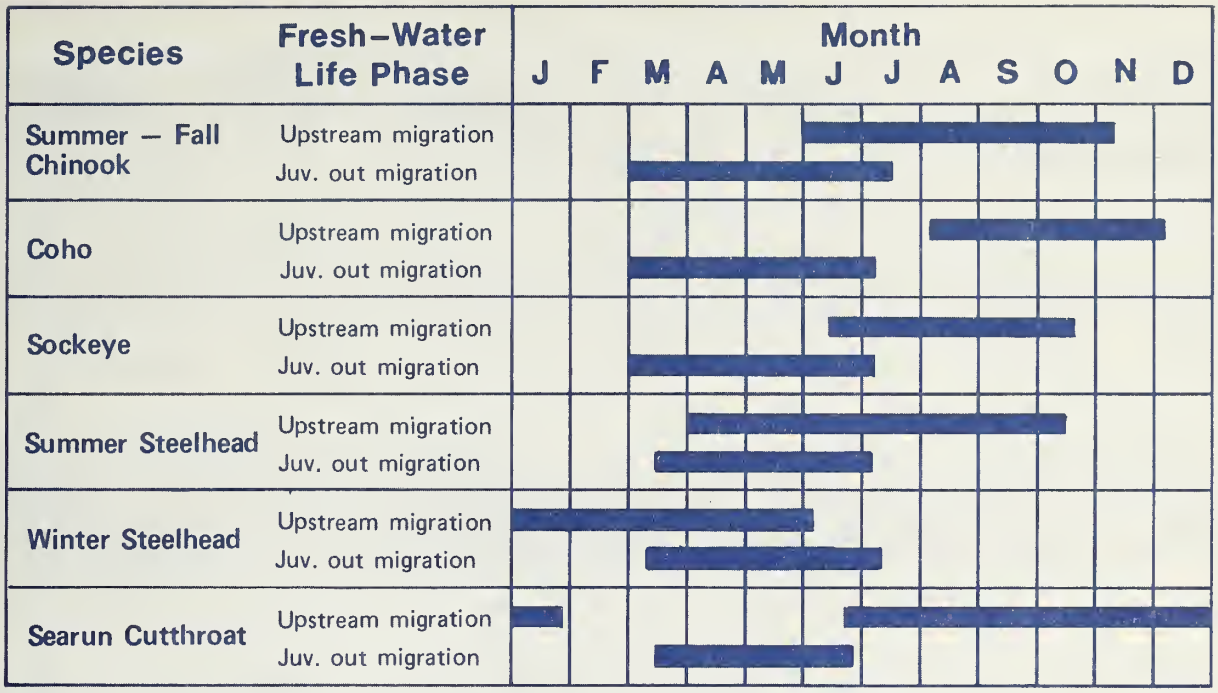


Historical Variation in Water Quality Parameters Lake Washington
Source, Demondson, 1972 and Edmondson, In Press

Figure B-1

Water Quality Summary of the Major Water Bodies in the Seattle Area

Timing of Salmon and Searun Trout Fresh-Water
Life Phases in the Lake Washington Drainage System.



Source: Puget Sound Task Force, Pacific Northwest River Basins Commission, Appendix XI

Figure B-2
Fish Migration

TABLE B-6

Sediment Analyses at the Kenmore Site[1]

	Location 1	Location 2	Background Water	Nearby Marina[2]
Total Solids %	30.6	69.5		45
	% Dry Basis			
Volatile Solids	14.5	1.8		17
COD	20.3	1.6		17
Oil and Grease	0.33	0.03		0.06
Sulfide	0.008	<0.001		0.18
	mg/l Elutriate Test			
Mercury	<0.001	<0.001	<0.001	
Lead	0.003	0.001	<0.001	
Copper	0.019	0.012	<0.001	

1) See Figure 2-6 for sample locations.

2) Mean of 8 sediment samples from a nearby marina (King County, 1977)

TABLE B-7

Fish Species Found in Pontiac Bay
in Order of Abundance

Peamouth

Yellow Perch

Northern Squawfish

Largemouth Bass

Black Crappie

Largescale Suckers

Sockeye

Brown Bullhead

Prickly Sculpin

Coho

Cutthroat Trout

Threespine Stickleback

Steelhead & Rainbow Trout

Chinook

Carp

Long Fin Smelt

Tench

Pumpkin Seed

Smallmouth Bass

Source: Shepard, 1975.

TABLE B-8

Water Quality Summary for the South Hylebos Waterway[3]

Sample Site[1]	CMB015	CMB106	CMB017
Water Temp °C	11.2 (17.2)[2]	11.9 (19.2)	12.0 (20.3)
Turbidity JTU	4.5 (15.0)	6.9 (140)	7.3 (23)
Salinity PPT	26. (16-37)	25. (17-35)	25. (14-37)
D.O. mg/l	7.9 (5.0)	8.0 (5.0)	7.4 (3.0)
Sulfite Waste Liquor PBI	7.1 (29)	6.4 (24)	8.9 (24)
Total Coliforms #/100 ml	830. (8400)	25. (34)	5000. (65,000)

1) For location, see Figures 2-10 and 2-12.

2) "Worst Case" values except for salinity where the range is given.

3) EPA STORET Data - 1969-1970 - all depths arranged.

TABLE B-9

Mean Concentrations of Sediment

Sediment Parameters From Six Sites in the Hylebos Waterway[1]

Total Solids %	66
	% Dry Basis
COD	5.2
Volatile Solids	3.4
Oil & Grease	0.06
Sulfide	0.024
	Elutriate Test (mg/l)
Zinc	0.003
Cadmium	0.003
Nickel	0.007
Mercury	less than 0.001
Lead	0.009
Copper	0.012
Chromium	0.053

1) See Figures 2-10 and 2-12 for sample site locations.

Source: Seattle District Army Corps of Engineers September 28, 1977

TABLE B-10

Sediment Analyses at the Manchester Site[1]

	Location 1	Location 2	Background Water
Total Solids %	78.8	77.8	
	% Dry Basis		
Volatile Solids	1.3	1.1	
COD	1.2	1.2	
Oil and Grease	0.06	0.04	
Sulfide	--	--	
	mg/l Elutriate Test		
Mercury	0.001	0.002	<0.001
Lead	0.006	0.012	0.005
Copper	0.007	<0.001	<0.001

1) See Figure 2-14 for sampling locations.

TABLE B-11

Sediment Analyses at the Lake Union Site[1]

	Location 1	Location 2	Background Water
Total Solids %	71.6	73.0	
	% Dry Basis		
Volatile Solids	1.6	2.1	
COD	1.7	2.5	
Oil and Grease	0.06	0.04	
Sulfide	<0.001	<0.001	
	mg/l Elutriate Test		
Mercury	<0.001	0.001	<0.001
Lead	<0.001	<0.001	<0.001
Copper	0.042	0.025	<0.001

1) See Figure 2-16 for sampling locations.

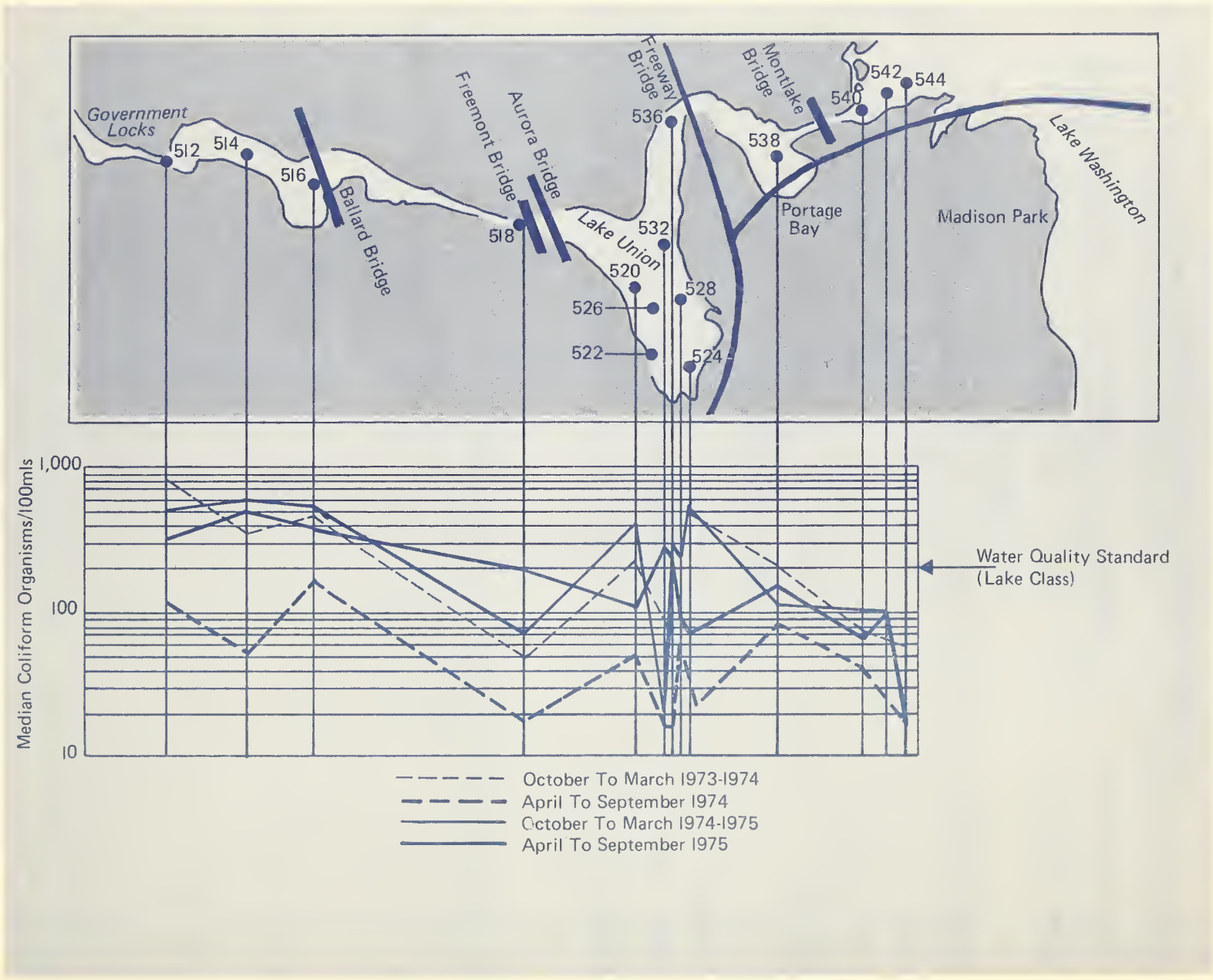


Figure B-3

Median Total Coliform Counts for Various Stations in the Lake Washington Ship Canal

TABLE B-12

Sediment Analyses at the Salmon Bay Site[1]

	Location 1	Location 2	Background Water
Total Solids %	42.8	18.8	
	% Dry Basis		
Volatile Solids	6.6	25.1	
COD	8.8	46.6	
Oil and Grease	0.24	0.42	
Sulfide	0.030	0.014	
	mg/l Elutriate Test		
Mercury	<0.001	0.001	<0.001
Lead	0.008	0.004	<0.001
Copper	0.042	0.024	<0.001

1) See Figure 2-20 for sampling locations.

APPENDIX C

AIR QUALITY

APPENDIX C

Operation of the proposed consolidated facility would generate emissions from ship light off and movement out of port and from automobile traffic to and from the facility. Both will be considered primary, long-term impacts in this analysis. Applicable standards are listed in Table C-1.

VESSEL EMISSIONS

Ship emissions would occur when ships operate their engines in preparation for departure and while in transit to and from port. The major pollutants emitted during these periods are total suspended particulates (TSP) and sulfur dioxide (SO_2). The greatest potential air quality impact occurs when the ships prepare to depart.

Basic assumptions and methodologies used in emissions calculations for vesels in transit:

- Trips Per Year and Estimated Transit Time - These data are shown in Table C-2. The transit time was estimated from observed data and typical vessel cruising speed in Puget Sound waters.
- Gallons of Fuel Consumed Per Year - Table C-3 presents the gallons of fuel consumed per year in transit to each of the identified alternative sites. As indicated, these values are obtained by multiplying the transit time by the specific fuel consumption for each vessel.
- Air Pollution Emission Factors - Emission factors for each of the vessels are shown in Table C-4.
- Annual Emission - Annual emissions were obtained by multiplying the emission factor by the fuel consumed. These results are presented in Table C-5.

Basic assumptions and methodologies used in emission calculations for vessels in port:

- A maximum of 2 ships preparing for departure simultaneously.
- The preparation time for the two ships, the OCEANOGRAPHER and the DISCOVERER is 2 hours.
- Atmospheric stability C and a 2 meter per second wind speed.
- Constant wind direction and speed.
- A 4 meter plume rise from the ships stacks.
- Stack height of 16 meters.

- A maximum of 4 ships can depart in any 24 hour period.
- Maximum concentrations occur at 0.2 km from source (Turners Workbook). Under C stability and 2 m/see,

$$\frac{xu}{Q} = 2.5 \times 10^{-4}$$

- No emissions occur in port upon return from sea.
- The sulfur content of "Navy Special" oil is 1 percent, that of diesel is 0.2 percent.
- Emission factors:

Pollutant	Emission Factor (cbs/1000 gallons)
Particulates	33 lbs/1000 gal*
Sulfur Oxides (SO_2)	27 lbs/1000 gal

*Based on diesel industrial engine emissions

- Fuel use during light off (Distillate Oil):

OCEANOGRAPHER	248 gal/2 hrs
DISCOVERER	248 gal/2 hrs

(On an annual basis, 5000 gallons of fuel are used by all ships during light off periods.)

- Emission Rates:

	Emission Rate (2/see)	
Averaging Time	Particulate	SO^2
1 hr.	-	0.84
24 hr.	0.086	0.07
Annual	0.00238	0.0194

o Based on above, concentration estimates were made using:

$$x = 2.5 \times 10^{-4} \frac{Q}{u}$$

u = 2 m/see

Q = emission rate (2/see)

SO_2 (1 hr.) Q = 10.84 2/see

$$x = (2.5 \times 10^{-4}) \frac{0.84}{} = 105 \text{ ug/m}^3$$

$$= 0.05 \text{ ppm}$$

TSP (24-hr.)

$$x = (2.5 \times 10^{-4}) \frac{0.086}{} = 20.8 \text{ ug/m}^3$$

The above estimates do not include adjustments or plume meander.

Expected maximum 1 and 24 hours SO_2 levels attributable to vessels are 0.06 ppm and 0.02 ppm at all sites except the South Mukilteo site where levels of 0.16 ppm and 0.04 ppm would be expected. TSP levels (24 hours) due to ship operations would be 7 ug/m^3 except at South Mukilteo, where 10 ug/m^3 levels would occur.

VEHICLE EMISSIONS

Three locations near each site were chosen for evaluation of air quality impacts caused by traffic. The locations and maximum 1 and 8 hour concentrations are shown in Tables C-6 and C-7. The EPA Mobile-1 computer program was used to estimate vehicle emission factors. Speed correction factors were applied to estimate the composite emission factor under assumed traffic conditions. Worst case meteorological conditions were assumed to persist for the duration of the averaging times (F stability; 1 meter/second wind speed; a wind blowing parallel to the road). The 1 hour calculations assumed an average route speed of 10 miles per hour while the 8 hour analyses assume the posted speed limits. Emission factors used were the latest developed by the Environmental Protection Agency (EPA, 1978). As indicated in the Tables, the expected concentrations would be well within standards, but there would be a rather large proportionate increase over existing concenterations in the mechanical mixing cell of the road. The mechanical mixing cell is an intense zone of mixing and turbulance over the road caused by the motion of vehicles.

TABLE C-1

AMBIENT AIR QUALITY STANDARDS

	Primary	National Secondary		Washington State		Puget Sound Region	
	ug/m^3	ug/m^3	Notes	ug/m^3	Notes	ug/m^3	Notes
SULFER OXIDES							
Annual Average	80		a	52	a	52	a
30-day Average						105	a
24-hour Average	365		b	262	b	262	a
3-hour Average		1300	b				
1-hour Average				655	c	655	c
1-hour Average				1048	b	1048	a
5-min. Average						2619	d
SUSPENDED PARTICULATES							
Annual Geom. Mean	75	60	a	60	a	60	a
24-hour Average	260	150	b	150	b	150	b
CARBON MONOXIDE							
8-hour Average	10,000	same	b	same		same	
1-hour Average	40,000		b				
PHOTOCHEMICAL OXIDANTS				same but			
1-hour Average	160	same	b	applies only 10 a.m.- 4 p.m. 4/1 thru 10/31		same as National	
NITROGEN DIOXIDE							
Annual Average	100	same	a	same		same	
PARTICLE FALLOUT				$grams/m^2/mo.$			
Industrial Area				10			
Commercial-Residential Areas				5			
HYDROCARBONS				same but			
(Less Methane)			b	applies only		same as	
3-hour Average	160	same	e	4/1 thru 10/31		National	

a Never to be exceeded
b Not to be exceeded more than once per year
c Not to be exceeded more than twice in seven days
d Not to be exceeded more than once in eight hours
e Applies to 3-hour period 6 to 9 a.m. daily Source: PSAPCA, 1977

TABLE C-2

TOTAL TIME EACH SHIP IS IN TRANSIT TO AND FROM

EACH SITE IN RELATION TO POINT ZERO (HOURS)

SHIP	TRIPS/HR.	SOUTH MUKILTEO	KENMORE	MANCHESTER	PORT OF TACOMA	HYLEBOS	PORT OF EVERETT	LAKE UNION	SAND POINT	SALMON BAY
OCEANOGRAPHER	12	9	39	31.9	19.9	24	8.2	28.4	25.5	37
DISCOVERER	6	4.5	19.7	16	10	12	4.1	14.2	12.7	18.5
SURVEYOR	6	4.5	19.7	16	10	12	4.1	14.2	12.7	18.5
FAIRWEATHER	6	4.5	19.7	16	10	12	4.1	14.2	12.7	18.5
RAINIER	4	3	73.1	10.6	6.6	8	2.7	2.7	8.5	12.3
MILLER FREEMAN	8	6	26.2	21.6	13.3	16	5.4	5.4	12.7	24.6
MCCARTHUR	6	4.5	19.7	16	10	12	4.1	4.1	17	18.5
DAVIDSON	6	4.5	19.7	16	10	12	4.1	4.1	12.7	18.5
OREGON	2	1.5	6.6	5.3	33	4	1.4	1.4	12.7	6.2
COBB	12	9	51.6	31.9	19.9	24	8.2	8.2	49	49
		6.8/ Yr. Ave.								

TABLE C-3

GALLONS OF FUEL CONSUMED PER YEAR IN TRANSIT

SHIP	(G/HR) RATE	SOUTH MUKILTEO	KENMORE	MANCHESTER	PORT OF TACOMA	HYLEBOS	PORT OF EVERETT	LAKE UNION	SALMON BAY	SAND POINT
OCEANOGRAPHER	292	2,628	11,388	9,315	5,810	7,008	2,394	8,293	7,446	10,804
DISCOVERER	292	1,314	5,752	4,672	2,920	3,504	1,197	4.246	3,708	5,402
SURVEYOR	260	1,170	5,122	4,160	2,600	3,120	1,066	3,692	3,302	4,810
FAIRWEATHER	166	747	3,270	2,656	1,660	1,992	681	2,357	2,108	3,071
RAINIER	166	498	2,175	1,760	1,096	1,328	448	1,577	1,411	2,042
MILLER FREEMAN	166	996	4,349	3,586	2,208	2,656	896	3,154	2,108	4,042
MCARTHUR	122	549	2,403	1,952	1,220	1,464	500	1,745	2,074	4,084
DAVIDSON	122	549	2,403	1,952	1,220	1,464	500	1,745	2,074	2,257
OREGON	40	60	264	212	132	160	56	188	508	248
COBB	40	360	2,604	1,276	796	960	328	1,640	1,520	2,960
TOTAL/SITE		8,871	39,190	31,541	19,656	23,656	8,066	28,537	26,259	36,935

Full usage based on distance traveled and average number of trips made in 1977.

TABLE C-4

EMISSION FACTORS (lb/10^3 gal)

Ship	HP	TSP*	SO_2	HC	CO	NO_2
Oceanographer	5,000	1.04	27	32.8	41.4	339.6
Discoverer	5,000	1.04	27	32.8	41.4	339.6
Surveyor	2,500	20	318	.682	3.45	55.8
Fairweather	2,400	1.04	27	16.8	78.3	391.7
Rainier	2,400	1.04	27	16.8	78.3	391.7
Miller Freeman	2,150	1.04	27	16.8	78.3	391.7
McArthur	1,600	1.04	27	----	44.6	623.1
Davidson	1,600	1.04	27	----	44.6	623.1
Oregon	600	1.04	27	24.1	77.6	349.2
Cobb	325	1.04	27	51.1	47.3	389.3

Factors from AR42, assume "cruise" mode. All diesel motorships; Surveyor is a steam turbine using residual "Navy Special" oil.

*In lb/hour of operation (except Surveyor)

**Assumes 2% sulfur oil

TABLE C-5

TOTAL POLLUTANT EMISSION (TONS/YEAR) DUE TO SHIP TRAVEL FOR EACH ALTERNATIVE

Alternative	Pollutant				
	TSP	SO_2	THC	CO	NO_x
Everett	0.03	0.26	0.09	0.19	1.42
South Mukilteo	0.04	0.29	0.09	0.21	1.56
Kenmore	0.16	1.26	0.41	0.89	6.79
Sand Point	0.15	1.19	0.38	0.85	6.42
North Hylebos	0.08	0.64	0.21	0.46	3.45
South Hylebos	0.10	0.78	0.25	0.55	4.17
Manchester	0.13	1.03	0.33	0.73	5.53
Lake Union (Split Site)	0.11	0.92	0.30	0.65	4.94
Salmon Bay (Split Site)	0.10	0.82	0.26	0.58	4.42

TABLE C-6

MAXIMUM ONE-HOUR CO CONCENTRATIONS (PPM) AT EACH PROJECT ALTERNATIVE SITE

Alternative	Location	Background	Without Project			With Project		
			M.C.a	10Mb	50Mb	M.C.a	10Mb	50Mb
Everett	1. Norton Avenue (South	2	5.2	4.5	2.3	6.9	5.9	2.4
South Mukilteo	1. SR 525 (North of Chenault Beach Road)	1	1.6	1.5	1.1	1.7	1.6	1.1
	2. SR 525 (South of Chenault Beach Road)	1	1.7	1.6	1.1	2.7	2.4	1.1
	3. Chenault Beach Road (At SR 525)	1	1.1	1.1	1.0	2.5	1.9	1.1
Kenmore	1. Juanita Drive (At SR 522)	1.5	20.3	16.5	3.0	23.5	19.1	3.3
	2. SR 522 (East of Juanita Drive)	1.5	26.3	21.3	3.5	26.3	21.3	3.5
	3. SR 522 (West of Juanita Drive)	1.5	32.0	25.9	3.9	36.6c	29.5	4.3
Sand Point (Consolidated)	1. Sand Point Way (North of NE 65th St)	2	8.1	6.9	2.5	9.4	7.9	2.6
	2. Sand Point Way (South of NE 65th St)	2	21.2	17.4	3.5	23.7	19.4	3.7
	3. NE 65th Street (West of Sand Point Way)	2	3.0	2.8	2.1	4.6	4.1	2.2

TABLE C-6 (Continued)

MAXIMUM ONE-HOUR CO CONCENTRATIONS (PPM) AT EACH PROJECT ALTERNATIVE SITE

Alternative	Location	Background	Without Project			With Project		
			M.C.a	10Mb	50Mb	M.C.a	10Mb	50Mb
North Hylebos	1. East 11th Street (North of Taylor Way)	2.5	8.9	7.6	3.0	11.8	9.9	3.2
	2. East 11th Street (South of Taylor Way)	2.5	9.7	8.3	3.1	10.4	8.8	3.1
	3. Taylor Way (At East 11th Street)	2.5	3.5	3.3	2.6	4.7	4.3	2.7
South Hylebos	1. East 11th Street (North of Taylor Way)	2.5	8.9	7.6	3.0	9.2	7.9	3.0
	2. East 11th Street (South of Taylor Way)	2.5	9.7	8.3	3.1	10.1	8.6	3.1
	3. Taylor Way (At East 11th Street)	2.5	3.5	3.3	2.6	4.7	4.3	2.7
Manchester	1. Beach Drive (At SR 160)	1	1.1	1.1	1.0	1.7	1.6	1.1
	2. SR 160 (East of Beach Drive)	1	1.3	1.2	1.0	1.9	1.7	1.1
	3. SR 160 (West of Beach Drive)	1	1.6	1.5	1.0	2.0	1.8	1.1
Lake Union (Split Site)	1. Fairview (At site entrance)	2.5	3.4	3.2	2.6	3.4	3.2	2.6
	2. Fairview N (At Jct. of Fairview E)	2.5	6.4	5.6	2.8	6.4	5.6	2.8

TABLE C-6 (Continued)

MAXIMUM ONE-HOUR CO CONCENTRATIONS (PPM) AT EACH PROJECT ALTERNATIVE SITE

Alternative	Location	Background	Without Project			With Project		
			M.C.a	10Mb	50Mb	M.C.a	10Mb	50Mb
Salmon Bay (Split Site)	1. NW Market Street (At 15th Ave., NW)	2.5	19.3	15.9	3.8	20.8	17.1	4.0
	2. 15th Avenue, NW (At Shilshole)	2.5	42.4c	34.4	5.7	42.8c	34.7	5.7
	3. Shilshole Avenue (At project site)	2.5	5.8	5.1	2.8	6.4	5.6	2.8
Sand Point (Split Site)	1. Sand Point Way (North of NE 65th St)	2	8.1	6.9	2.5	9.0	7.6	2.6
	2. Sand Point Way (South of NE 65th St)	2	21.2	17.4	3.5	23.3	19.0	3.7
	3. NE 65th Street (West of Sand Point Way)	2	3.0	2.8	2.1	4.3	3.8	2.2

Source: URS Company

a Mixing Cell Concentration
b Concentration at given distance (meters) from road shoulder
c Exceeds established standard

TABLE C-7

MAXIMUM EIGHT-HOUR CO CONCENTRATIONS (PPM) AT EACH PROJECT ALTERNATIVE SITE

Alternative	Location	Background	Without Project			With Project		
			M.C.a	10Mb	50Mb	M.C.a	10Mb	50Mb
Everett	1. Norton Avenue (South	2	4.2	3.8	2.2	4.7	4.2	2.2
South Mukilteo	1. SR 525 (North of Chenault Beach Road)	1	1.4	1.3	1.0	1.5	1.4	1.0
	2. SR 525 (South of Chenault Beach Road)	1	1.4	1.3	1.0	1.5	1.4	1.0
	3. Chenault Beach Road (At SR 522)	1	1.1	1.1	1.0	1.6	1.5	1.1
Kenmore	1. Juanita Drive (At (SR 525)	1.5	4.9	4.2	1.8	5.0	4.3	1.8
	2. SR 522 (East of Juanita Drive)	1.5	5.5	4.7	1.8	5.5	4.7	1.8
	3. SR 522 (West of Juanita Drive)	1.5	7.6	6.4	2.0	7.7	6.5	2.0
Sand Point	1. Sand Point Way (North of NE 65th St)	2	3.3	3.0	2.1	3.4	3.1	2.1
	2. Sand Point Way (South of NE 65th St)	2	5.5	4.8	2.3	5.8	5.1	2.3
	3. NE 65th Street (West of Sand Point Way)	2	2.3	2.2	2.0	2.4	2.3	2.0

TABLE C-7 (Continued)

MAXIMUM EIGHT-HOUR CO CONCENTRATIONS (PPM) AT EACH PROJECT ALTERNATIVE SITE

Alternative	Location	Background	Without Project			With Project		
			M.C.a	10Mb	50Mb	M.C.a	10Mb	50Mb
North Hylebos	1. East 11th Street (North of Taylor Way)	2.5	4.5	4.1	2.7	4.9	4.4	2.7
	2. East 11th Street (South of Taylor Way)	2.5	4.7	4.3	2.7	4.8	4.3	2.7
	3. Taylor Way (At East (East 11th Street)	2.5	2.8	2.7	2.5	2.9	2.8	2.5
South Hylebos	1. East 11th Street (North of Taylor Way)	2.5	4.5	4.1	2.7	4.5	4.1	2.7
	2. East 11th Street (South of Taylor Way)	2.5	4.7	4.3	2.7	4.8	4.3	2.7
	3. Taylor Way (At East 11th Street)	2.5	2.8	2.7	2.5	2.9	2.8	2.5
Manchester	1. Beach Drive (At SR 160)	1	1.1	1.1	1.0	1.3	1.2	1.0
	2. SR 160 (East of Beach Drive)	1	1.2	1.2	1.0	1.3	1.2	1.0
	3. SR 160 (West of Beach Drive)	1	1.4	1.3	1.0	1.5	1.4	1.0
Lake Union (Split Site)	1. Fairview (At site entrance)	2.5	2.8	2.7	2.5	2.8	2.7	2.5
	2. Fairview N (At Jct. of Fairview E)	2.5	3.4	3.2	2.6	3.4	3.2	2.6

TABLE C-7 (Continued)

MAXIMUM EIGHT-HOUR TO CONCENTRATIONS (PPM) AT EACH PROJECT ALTERNATIVE SITE

Alternative	Location	Background	Without Project			With Project		
			M.C.a	10Mb	50Mb	M.C.a	10Mb	50Mb
Salmon Bay (Split Site)	1. NW Market Street (At 15th Ave, NW)	2.5	7.4	6.4	2.9	7.5	6.5	2.9
	2. 15th Avenue, NW (At Shilshole)	2.5	12.1c	10.2c	3.3	12.1c	10.2c	3.3
	3. Shilshole Avenue (At project site)	2.5	3.4	3.2	2.6	3.6	3.3	2.6
Sand Point	1. Sand Point Way (North of NE 65th St)	2	3.3	3.0	2.1	3.4	3.1	2.1
	2. Sand Point Way (South of NE 65th St)	2	5.5	4.8	2.3	5.7	5.0	2.3
	3. NE 65th Street (West (of Sand Point Way)	2	2.3	2.2	2.0	2.4	2.3	2.0

Source: URS Company

a Mixing Cell Concentration
b Concentration at given distance in meters from road shoulder
c Exceeds established standard

APPENDIX D

NOISE

APPENDIX D

NOISE

Noise level measurements were conducted by URS from May 4, 1978 to May 10, 1978 to determine the current noise environment in the vicinity of the alternate NOAA sites.

URS noise measurements were made with a battery-powered Bruel and Kjaer Type 166B/S45 sound level meter equipped with a windscreen. The "A-weighting" scale set on slow response was used for all measurements. The sampling period lasted approximately 20 minutes each for three daily time periods (morning, afternoon, and evening). The results of the survey are presented in Table D-1 for noise levels of L_{50}, L_{10}, $L_{eq(24)}$, and L_{dn}.

Table D-1

RESULTS OF NOISE SURVEY FOR NOAA

Site	Date	Time	Location	Noise Levels (dBA) L_{50}	L_{10}	$L_{eq(24)}$	L_{dn}	Comments
Salmon Bay								
1.	5-5-78	8:30 a.m.	Corner of 20th Avenue, NW	66	72			Heavy car & truck
	5-4-78	2:10 p.m.	& Shilshole Avenue, NW	65	73	63	65	traffic on Shilshole
	5-5-78	9:10 p.m.		54	64			Ave. in morning and afternoon
2.	5-5-78	8:10 a.m.	Corner of NW 46th Street and	61	64			Heavy car & truck
	5-4-78	2:40 p.m.	Shilshole Avenue, NW	60	72	60	66	traffic on Shilshole
	5-5-78	9:35 p.m.		63	74			Ave. in morning and afternoon
Lake Union								
3.	5-5-78	9:20 a.m.	Corner of Fairview Avenue, E	61	68			Car traffic on
	5-4-78	4:55 p.m.	& E. Garfield Street	64	76	62	66	Fairview Avenue, E
	5-5-78	10:20 p.m.		58	64			
Kenmore								
4.	5-8-78	8:20 a.m.	200' from Juanita Drive on	63	73			Noise from lumber
	5-4-78	3:35 p.m.	NE 175th Street	61	76	59	63	company and vehicles
	5-7-78	9:45 p.m.		53	61			on State Route 522
5.	5-8-78	8:45 a.m.	Boat launch area on	58	63			
	5-4-78	4:05 p.m.	Sammamish River	59	62	57	60	
	5-7-78	10:10 p.m.		52	60			
South Mukilteo								
6.	5-6-78	8:05 a.m.	North end of Marine View Drive	40	44			Bird noises
	5-6-78	1:10 p.m.		38	43	38	42	
	5-9-78	8:45 p.m.		35	37			
7.	5-6-78	8:30 a.m.	South end of Marine View Drive	44	50			Bird noises
	5-6-78	1:40 p.m.		41	48	41	43	
	5-9-78	9:10 p.m.		35	36			
Manchester								
8.	5-8-78	11:30 a.m.	400' inside of gate	49	57			Motor Boat noise in
	5-6-78	4:05 p.m.		41	53	45	50	background
	5-8-78	9:30 p.m.		43	51			
North Hylebos								
9.	5-5-78	11:10 a.m.	On Marine View Drive at west	55	69			Traffic noise on
	5-5-78	4:15 p.m.	end of site	57	68	55	59	Marine View Drive
	5-6-78	9:55 p.m.		53	61			
10.	5-5-78	11:35 a.m.	400' north of 11th Street Bridge	55	63			Traffic noise on
	5-5-78	3:30 p.m.		57	63	55	59	11th Street
	5-6-78	10:20 p.m.		51	60			
South Hylebos								
11.	5-5-78	10:35 a.m.	Between Western Farmers	57	60			Saw mill noise in
	5-5-78	3:30 p.m.	Association & small powerplant	56	64	56	61	background
	5-6-78	9:30 p.m.		54	61			
Port of Everett								
12.	5-10-78	9:30 a.m.	Near gear company	61	67			Truck & car traffic,
	5-10-78	1:00 p.m.		59	62	59	63	wood chip noise in
	5-9-78	9:50 p.m.		56	64			background

Table D-2

AVERAGE NOISE LEVEL (dBA) AT CONSTRUCTION SITES WITH A 50 dBA AMBIENT TYPICAL OF SUBURBAN RESIDENTIAL AREAS

	Domestic Housing		Office Building Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious, Amusement & Recreation, Store, Service Station		Public Works, Roads & Highways, Sewers and Trenches	
	I	II	I	II	I	II	I	II
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundation	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I = All pertinent equipment present at site.
II = Minimum required equipment present at site.

Source: Anon., "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances," U.S. Environmental Protection Agency, December 1971.

TABLE D-3

CALCULATED NOISE LEVELS FOR PEAK-HOUR TRAFFIC VOLUMES AT 100 FEET
USING NATIONAL COOPERATIVE HIGHWAY RESEARCH REPORT 117 TABLES

Site and Road	1983 Traffic Conditions						Change in Noise Levels	
	Without Project			With Project				
	Peak-Hour Volume	L_{50}	L_{10}	Peak-Hour Volume	L_{50}	L_{10}	L_{50}	L_{10}
Everett Site								
So. On Norton Avenue	986	59	63	1,555	60	63	+1	0
South Mukilteo Site								
No. of State Route 525	555	56	61	654	56	61	0	0
So. on State Route 525	626	56	61	1,536	60	63	+4	+2
Chenault Beach Road	55	39	51	815	57	62	+18	+11
Kenmore Site								
Juanita Drive	2,233	62	65	2,610	63	65	+1	0
E. on State Route 522	2,957	63	65	2,957	63	65	0	0
W. on State Route 522	3,633	65	67	4,162	65	67	0	0
Sand Point Site								
No. on Sand Point Way	872	58	63	1,062	59	63	+1	0
So. on Sand Point Way	2,737	63	65	3,080	63	65	0	0
West on NE 65th St.	141	46	56	369	53	60	+7	+4
North Hylebos Site								
No. on E 11th St.	1,638	60	63	2,398	62	65	+2	+2
So. on E 11th St.	1,853	61	64	2,043	61	64	0	0
E. on Taylor Way	473	55	60	1,043	58	62	+3	+2

TABLE D-3 (Continued)

CALCULATED NOISE LEVELS FOR PEAK-HOUR TRAFFIC VOLUMES AT 100 FEET
USING NATIONAL COOPERATIVE HIGHWAY RESEARCH REPORT 117 TABLES

Site and Road	1983 Traffic Conditions Without Project: Peak-Hour Volume	L_{50}	L_{10}	1983 Traffic Conditions With Project: Peak-Hour Volume	L_{50}	L_{10}	Change in Noise Levels L_{50}	Change in Noise Levels L_{10}
South Hylebos Site								
No. on E 11th St.	1,638	60	63	1,715	61	64	+1	+1
So. on E 11th St.	1,853	61	60	1,967	61	64	0	0
E. on Taylor Way	473	55	60	1,043	58	62	+3	+2
Split Sites								
Lake Union*								
Salmon Bay								
E on NW Market	1,600	60	63	1,737	61	64	+1	+1
So. on 15th Ave. NW	3,860	64	66	3,888	64	66	0	0
So. on Shilshole	792	57	62	926	59	63	+2	+1
Sand Point								
No. on Sand Point Way	872	57	62	997	58	62	+1	0
So. on Sand Point Way	2,737	63	65	3,048	63	65	0	0
W. on NE 65th St.	141	46	56	328	53	60	+7	+4

*The Lake Union Site will cause a shift in the traffic patterns to other sites but major arteries noise levels will not change.

APPENDIX E

TERRESTRIAL BIOLOGY

TABLE E-1

DOMINANT PLANT SPECIES IDENTIFIED AT ALTERNATIVE SITE LOCATIONS[1]

Common Name	Scientific Name	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
Horsetail	Equisetum spp.	X			X			X	X	X
Sword fern	Polystichum munitum		X							
Bracken fern	Pteridium aquilinum		X							
Douglas-fir	Pseudotsuga menzeisii		X							
Black cottonwood	Populous trichocarpa			X						
Willow	Salix spp.									
Alders	Alnus spp.			X						
Red alder	Alnus rubra		X							
Stinging nettle	Urtica dioica		X							
Dock	Rumex spp.		X					X		
Miner's lettuce	Montia perfoliata		X							
Western spring beauty	Montia siberica		X							
Fringecup	Tellima grandiflora		X							
Blackberry	Rubus spp.		X	X			X			
Salmonberry	Rubus spectabilis		X							
Scotch broom	Cytisus scoparius			X	X			X		
Lupine	Lupinus spp.				X	X		X	X	X
Clover	Trifolium spp.	X			X	X		X	X	X
Vetch	Vica spp.	X			X	X		X	X	X
Vine maple	Acer circinatum		X							
Big-leaf maple	Acer macrophyllum		X							
Oregon ash	Fraxinus latifolia		X							
Small bindweed	Convolvulous arvensis					X				
Mullein	Verbascum spp.						X			
Plantain	Plantago spp.	X			X				X	X
Bedstraw	Galium spp.		X							
Thistle	Cirsium spp.					X				
Rush	Juncus spp.		X							
Sedge	Carex spp				X					
Grasses	Gramineae	X			X	X	X	X	X	X
Common Cattail	Typha latifolia			X						

[1]Nomenclature follows Hitchcock and Cronquist (1976).

TABLE E-2

BIRD SPECIES THAT MAY BE FOUND AT
ALTERNATE SITE LOCATIONS AND ADJACENT WATERS[1]

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
GAVIIDAE - LOONS									
Common Loon	X	X			X	X	X		
Arctic Loon	X	X			X	X	X		
Red-throated Loon	X	X		X	X	X	X		
PODICIPEDIDAE - GREBES									
Red-necked Grebe	X	X	X	X	X	X	X	(X)	X
Horned Grebe	X	X			X	X	X		
Eared Grebe	X	(X)	X	X	X	X	X	(X)	(X)
Western Grebe	X	(X)	X	(X)	X	X	X	X	X
Pied-billed Grebe			X	X				X	X
PROCELLARIIDAE - FULMARS, SHEAR WATERS, PETRELS									
Sooty Shearwater	X	X			X	X	X		
PHALACROCORICIDAE - CORMORANTS									
Double-crested Cormorant	X	X			X	X	X		
Brandt's Cormorant	X	X			X	X	X		
Pelagic Cormorant	X	X			X	X	X		
ARDEIDAE - HERONS AND BITTERNS									
Great Blue Heron	X	(X)	X	(X)	X	X	X	X	X
Great Egret ("Common")	X	X				X			
Black-crowned Night Heron			X	X				X	X
ANATIDAE - WATERFOWL									
Whistling Swan	X	X			X	X	X		
Canada Goose	X	X	X	(X)	X	(X)	X	X	X
Brant	X	X			X	X	X		
Snow Goose	X	X			X	X	X		
Mallard	X	X	X	X	X	X	X	(X)	X

TABLE E-2 (Continued)

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
ANATIDAE - WATERFOWL (Continued)									
Gadwall			X	X				X	X
Pintail	X	X	X	X	X	X	X	X	X
Green-winged Teal	X	X	X	X	X	X	X	X	X
Blue-winged Teal			X	X				X	X
Cinnamon Teal			X	X				X	X
American Wigeon	X	X	X	X	X	X	X	X	X
Shoveler	X	X	X	X	X	X	X	X	X
Redhead			X	X				X	X
Ring-necked Duck			X	X				X	X
Canvasback	X	X	X	X	X	X	X	X	X
Greater Scaup	X	X			X	X	X		
Lesser Scaup	X	X	X	X	X	X	X	X	X
Common Goldeneye	X	X	X	X	X	X	X	X	X
Barrow's Goldeneye	X	X	X	X	X	X	X	X	X
Bufflehead	X	X	X	X	X	X	X	X	X
Oldsquaw	X	X			X	X	X		
Harlequin Duck	X	X			X	X	X		
White-winged Scoter	X	X			X	X	X		
Surf Scoter	X	X			X	X	X		
Ruddy Duck	X	X	X	X	X	X	X	X	X
Common Merganser	X	X	X	X	X	X	X	X	X
Red-breased Merganser	X	X			X	X	X		
ACCIPITRIDAE - HAWKS AND EAGLES									
Red-tailed Hawk		X							
Bald Eagle	X	X			X	X	X		
Marsh Hawk				(X)					
FALCONIDAE -FALCONS									
American Kestrel		X		(X)			X		
TETRAONIDAE - GROUSE AND PTARMIGAN									
Ruffed Grouse		X							

TABLE E-2 (Continued)

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
PHASIANIDAE - QUAIL, PARTRIDGES AND PHEASANTS									
California Quail				(X)			X		
Ring-necked Pheasant				(X)					
RALLIDAE - RAILS, GALLINULES AND COOTS									
American Coot	X	X	X	X	X	X	X	X	X
HAEMATOPODIDAE - OYSTERCATCHERS									
Black Oystercatcher		X							
CHARADRIIDAE - PLOVERS, SURFBIRDS, AND TURNSTONES									
Semipalmated Plover					X		X		
Killdeer			X	X	X	(X)	(X)		
Black-bellied Plover					X		X		
Surfbird		X							
Black Turnstone		X					X		
SCOLOPACIDAE - SANDPIPERS AND ALLIES									
Common Snipe			X	(X)	X		X	X	X
Whimbrel							X		
Spotted Sandpiper			X	X	X		X	X	X
Greater Yellowlegs			X	X	X		X	X	X
Lesser Yellowlegs			X	X	X		X	X	X
Red Knot					X		X		
Pectoral Sandpiper			X	X	X		X	X	X
Baird's Sandpiper				X	X			X	X
Least Sandpiper			X	X	X		X	X	X
Dunlin					X		X		
Short-billed Dowitcher					X		X		
Long-billed Dowitcher			X	X	X		X	X	X
Western Sandpiper			X	X				X	X
Sanderling					X		X		

TABLE E-2 (Continued)

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
PHALAROPODIDAE - PHALAROPES									
Wilson's Phalarope			X	X				X	X
Northern Phalarope	X	X			X	X	X		
STERCORARIDAE - JAEGERS AND SKUAS									
Parasitic Jaeger	X	X			X	X	X		
LARIDAE - GULLS AND TERNS									
Glaucous-winged Gull	X	X			X	X	X		
Western Gull	X	X			X	X	X		
Herring Gull	X	X	X	X	X	X	X	X	X
Thayer's Gull	X	X			X	X	X		
California Gull	X	X	X	X	X	X	X	X	X
Ring-billed Gull	X	X	X	X	X	X	X	X	X
Mew Gull	X	X			X	X	X		
Bonaparte's Gull	X	X	X	X	X	X	X	X	X
Heermann's Gull	X	X			X	X	X		
Black-legged Kittikake	X	X			X	X	X		
Sabine's Gull	X	X			X	X	X		
Common Tern	X	X			X	X	X		
Caspian Tern	X	X			X	X	X		
ALCIDAE - ALCIDS									
Common Murre	X	X			X	X	X		
Pigeon Guillemot	X	X			X	X	X		
Marbled Murrelet	X	X			X	X	X		
Cassin's Auklet	X	X			X	X	X		
Rhinoceros Auklet	X	X			X	X	X		
Tufted Puffin	X	X			X	X	X		
COLUMBIDAE - PIGEONS AND DOVES									
Rock Dove	(X)	X	X	X		X	X	X	X
Mourning Dove				(X)			X		

TABLE E-2 (Continued)

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
STRIGIDAE - OWLS									
Screech Owl		X					X		
Great Horned Owl		X							
Snowy Owl							X		
Barred Owl		X							
CAPRIMULGIDAE - GOATSUCKERS									
Common Nighthawk							X		
APODIDAE - SWIFTS									
Vaux' Swift		X							
TROCHILIDAE - HUMMINGBIRDS									
Rufous Hummingbird		X		X			X		
ALCEDINIDAE - KING FISHERS									
Belted Kingfisher			X	X	X		X		
PICIDAE - WOODPECKERS									
Common Flicker		X					X		
Pileated Woodpecker		(X)							
Yellow-bellied Sapsucker		X					X		
Downy Woodpecker		(X)					X		
TYRANNIDAE - TYRANT FLYCATCHERS									
Willow Flycatcher ("Traills")		X							
Western Wood Pewee		X							
HIRUNDINIDAE - SWALLOWS									
Violet-green Swallow		X	X	X			X	X	X
Tree Swallow		X	X	X			X	X	

TABLE E-2 (Continued)

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
HIRUNDINIDAE - SWALLOWS (Continued)									
Bank Swallow			X	X				X	
Rough-winged Swallow			X	X				X	
Barn Swallow		(X)	X	X			X	X	
Cliff Swallow		X	X	X			X	X	
CORVIDAE - JAYS, CROWS AND MAGPIES									
Steller's Jay		(X)		X			X		
Common Crow	X	(X)	X	(X)	X	(X)	X	X	X
PARIDAE - CHICKADEES, TITMILE AND ALLIES									
Black-capped Chickadee		X		X			X		
Common Bushtit		(X)		X			(X)		
SITTIDAE - NUTHATCHES									
White-breasted Nuthatch		X							
Red-breasted Nuthatch		X							
TROGLODYTIDAE - WRENS									
House Wren		X		X			X		
Winter Wren		X							
Bewick's Wren		X		X			X		
TURDIDAE - THRUSHES, SOLITAIRES AND BLUEBIRDS									
American Robin		(X)		X			(X)		
Varied Thrush				X			X		
Hermit Thrush		X		X			X		
SYLVIIDAE - GNATCATCHERS AND KINGLETS									
Golden-crowned Kinglet		X		X			X		
Ruby-crowned Kinglet		X		X			X		

TABLE E-2 (Continued)

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
MOTACILLIDAE - PIPITS AND WAGTAILS									
Water Pipet					X		X		
BOMBYCILLIDAE - WAXWINGS									
Cedar Waxwing		X		X			X		
STURNIDAE - STARLINGS									
Starling	X	X	X	X	X	X	X	X	X
PARULIDAE - WOOD WARBLERS									
Orange-crowned Warbler		X		X			X		
Washville Warbler		X							
Yellow Warbler		X							
MacGillivray's Warbler		X							
Wilson's Warbler		X							
PLOCEIDAE - WEAVER FINCHES									
House Sparrow	X		X	(X)	X	X	X	X	X
ICTERIDAE - BLACKBIRDS AND ORIOLES									
Western Meadowlark				(X)			X		
Red-winged Blackbird				X		X	X		
Northern Oriole ("Bullock's")		X		X			X		
Brewer's Blackbird				X			X		
Brown-headed Cowbird		X		X			X		
FRINGILLIDAE - GROSBEAKS, FINCHES, SPARROWS AND LONGSPURS									
Black-headed Grosbeak		X							
Evening Grosbeak		X		X			X		
Purple Finch		X		X			X		
House Finch				X		X	X		
Pine Siskin		X					X		

TABLE E-2 (Continued)

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
FRINGILLIDAE - GROSBEAKS, FINCHES, SPARROWS AND LONGSPURS (Continued)									
American Goldfinch		X		X			X		
Rufous-sided Towhee		(X)		X			X		
Dark-eyed Junco		X		X			X		
Tree Sparrow				(X)					
Chipping Sparrow		X							
White-crowned Sparrow		X		X		X	X		
Golden-crowned Sparrow		X		X		X	X		
Fox Sparrow		X							
Song Sparrow		(X)		X	X	X	X		
Lapland Longspur				(X)					
Snow Bunting				(X)					

[1]Occurences are adapted from habitat preferences given in Wahl and Paulson (1977). Species names follow the American Ornithologist's Union Checklist (A.O.U., 1957), with 1974 updates (A.O.U., 1974).

(X) - Observed on site during field observations or in Seattle Audubon Society Records (NOAA, 1976).

TABLE E-3

REPTILES AND AMPHIBIANS THAT MAY OCCUR AT ALTERNATIVE SITES[1]

	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
- Pacific Giant Salamander Dicamptodon ensatus									
- Northwestern Salamander Ambystoma gracile		X							
- Ensatina Ensatina eschscholtzi									
- Rough-skinned Newt Taricha granulosa		X							
- Western Red-backed Salamander Plethodon vehiculum		X							
- Western Toad Bufo boreas		X							
- Pacific Treefrog Hyla regilla		X							
- Western Fence Lizard Sceloporous occidentalis		X		X		X	X		
- Northern Alligator Lizard Gerrhonotus coeruleus principis		X		X		X	X		
- Rubber Boa Charina bottae bottae		X							
- Common Garter Snake Thamnophis sirtalis pickeringi		X		X			X		
- Western Terrestrial Garter Snake Thamnophis elegans vagrans		X		X			X		

[1]Occurances are adapted from ranges and habitat preferences given in Stebbins, (1966).

TABLE E-4

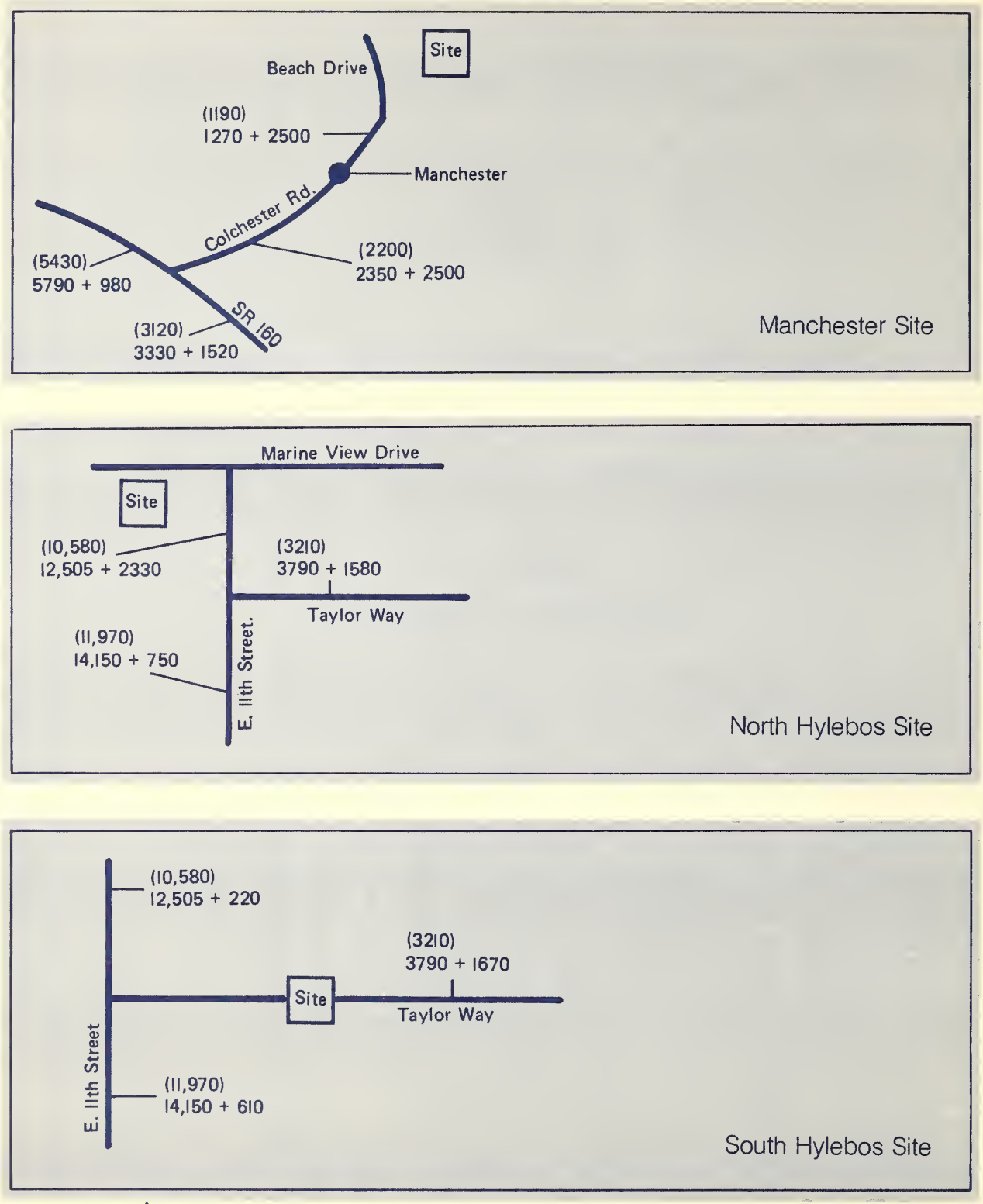
MAMMALS WHICH MAY BE FOUND AT ALTERNATIVE SITE LOCATIONS[1]

Common Name	Scientific Name	Everett	South Mukilteo	Kenmore	Sand Point	North Hylebos	South Hylebos	Manchester	Lake Union	Salmon Bay
Masked Shrew	Sorex cinereus		X					X		
Vagrant Shrew	Sorex vagrans									
Shrew Mole	Neurotrichus gibbsi		X							
Townsend Mole	Scapanus townsendi		X							
Deer Mouse	Peromyscus maniculatus		X		X		X	X		
Oregon Vole	Microtus oregoni		X		X			X		
Townsend Mole	Microtus townsendi		X					X		
House Mouse	Mus musculus	X			X		X	X	X	X
Norway Rat	Rattus norvegicus	X			X		X	X	X	X
Pacific Jumping Mouse	Zapus trinotatus		X					X		
Raccoon	Procyon lotor		X		X					
Striped Skunk	Mephitis mephitis		X					X		
Spotted Skunk	Spilogale putorius		X					X		

[1]Nomenclature and occurences are from Burt and Grossenheider, (1964).

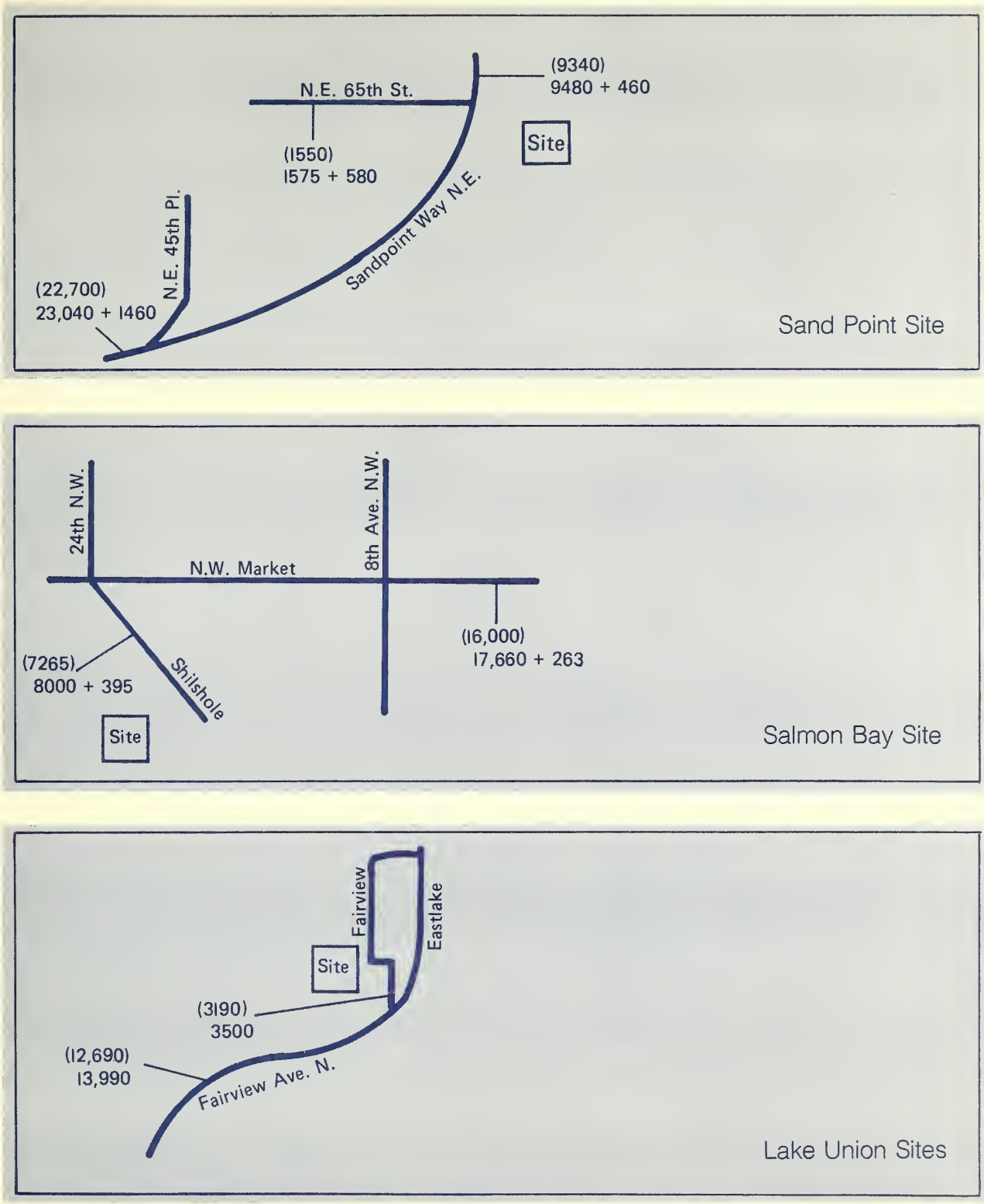
APPENDIX F

TRANSPORTATION AND CIRCULATION



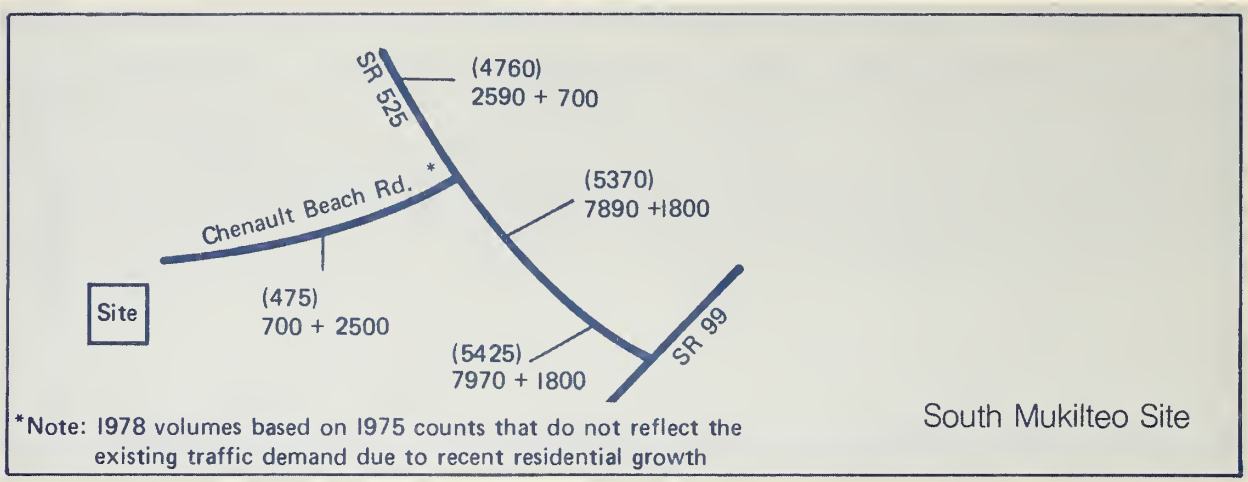
Legend | (1978) Existing Traffic
1983 + NOAA Projected Traffic + NOAA Traffic

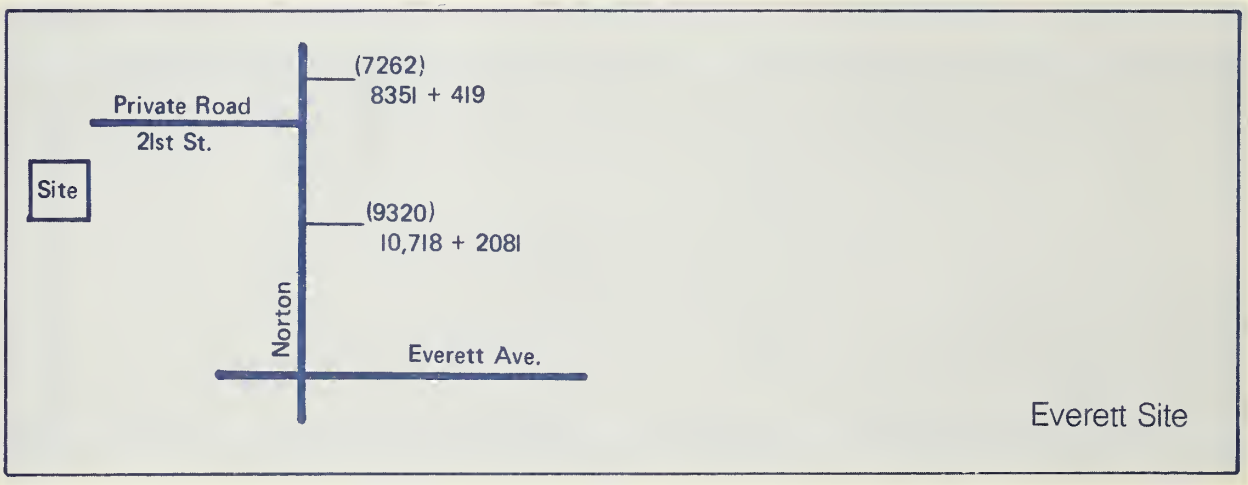
Figure F-1a
Traffic Volumes

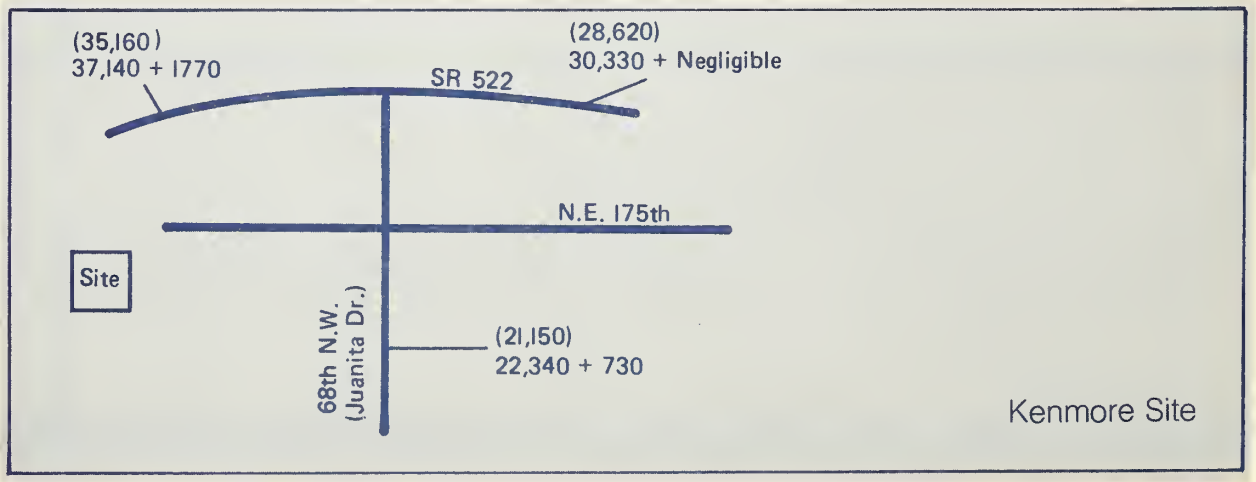


Legend | (1978) Existing Traffic
1983 + NOAA Projected Traffic + NOAA Traffic

Figure F-1b
Traffic Volumes







Legend | (1978) Existing Traffic
1983 + NOAA Projected Traffic + NOAA Traffic

Figure F1c
Traffic Volumes

APPENDIX G

CONSISTENCY OF PROPOSED PROJECT WITH THE WASHINGTON COASTAL ZONE MANAGEMENT PROGRAM

APPENDIX G

CONSISTENCY OF PROPOSED PROJECT WITH
THE WASHINGTON COASTAL ZONE MANAGEMENT PROGRAM*

PROJECT TITLE: Vessel Pier and Lagoon Construction

The proposed project will consist of construction of four concrete piers on Lake Washington ranging in length from 330 feet to 475 feet and three concrete small boat piers, one of 40 feet and two of 130 feet as measured from the existing shoreline. Completion of the proposed piers will require:

1. Dredging of approximately 380,000 cubic yards of lake bottom material;

2. Erection of a riprap revetment to protect shoreward face of the dredge area;

3. Filling behind the riprap revetment with approximately 1,000 cubic yards of dredged material;

4. Disposal of excess dredged material on upland site behind water containment berm;

5. Installation of concrete or steel pilings to support the proposed piers.

The project will also include the creation of a two-acre lagoon which will require:

1. The upland excavation of approximately 80,000 cubic yards of material;

2. The dredging of approximately 20,000 cubic yards of lake bottom material; disposal of excavated and dredged materials on upland site behind water containment berm;

3. The construction of a lagoon connected to and at a level higher than Lake Washington utilitizing a circulating pump system.

* This document was prepared by the legal staff of NOAA for the Sand Point Project.

The purpose of the project is to provide moorage for up to twelve (12) NOAA scientific research vessels. Small piers will be used for hydrographic launches and small reconnaissance craft.

PROJECT LOCATION

The proposed piers and lagoon will be located on the west side of Lake Washington on the geographical site known as Sand Point in Seattle, Washington. The described area is in the second tier for the purposes of the Washington Coastal Zone Management Program and is designated a Conservancy Management (CM) shoreline environment in the Seattle Shoreline Master Program.

CONSISTENCY OF PROJECT WITH APPROVED STATE MANAGEMENT PROGRAM:

The proposed project complies with the Washington Coastal Zone Management Program and the regulations of the Seattle Shoreline Master Program and will be conducted in a manner consistent with those programs to the maximum extent practicable.

1. The proposed project complies with the Washington Coastal Zone Management Program and will be conducted in a manner consistent therewith to the maximum extent practicable.

    a. Recognize and protect the state-wide interest over local interest.

        Marine and oceanographic research efforts of NOAA vessels provide a wide array of benefits in the broad public interest. Activities of marine-related scientific research vessels and availability of the lagoon as an aesthetic amenity and potential aquaculture experiment station are water-dependent uses which will protect and promote long-term state and national interests over local interests.

    b. Preserve the natural character of the shoreline.

        The completed project will upgrade and redevelop shoreline areas where development has previously occurred in the form of bulkheading, runways, and float plane ramps. Creation of the lagoon will provide additional shoreline to the site, available for limited public use.

    c. Result in long-term over short-term benefits.

        The continuing research function of NOAA vessels will provide long-term benefits in the broad public interest.

d. Protect resources and ecology of shorelines.

Pier construction plans provide for riprapping to protect the shoreline from the effects of erosion and sedimentation. Irretrievable loss of shoreline resources due to pier construction will be negligible. Creation of the lagoon will reestablish much of the ecological balance of the area lost to prior development.

e. Increase public access to publicly-owned areas of the shorelines.

The shoreline is presently owned by NOAA. Former use of the site as a Naval Air Station precluded public use for security and safety reasons. When the site is operational, observation areas will, however, be provided for visitors, limited as to hours of availability, types of activity permitted, location and area.

f. Increase recreational opportunities for the public on the shoreline.

Public recreational opportunities on the shoreline will be greatly increased over opportunities provided by the previous owner of the site but will be limited to regulated public observation as noted above.

2. The proposed project complies with the regulations of the Seattle Shoreline Master Program and will be conducted in a manner consistent therewith to the maximum extent practicable.

a. Research and Educational Use

The proposed project will occur in an area designated Conservancy Management (CM) shoreline environment. NOAA's water-dependent scientific research use of the site is permitted in the CM shoreline environment.

The proposed project will not have an adverse impact upon the surrounding neighborhood by reason of the bulk or type of materials, heavy equipment or machinery, noise, odor, traffic or related characteristics.

b. Dredging and Spoil Disposal

Benthic organisms in the dredge area will be removed or buried during dredging. The benthic community is expected to regenerate slowly and will not be significantly affected by NOAA pier area operations. It is expected that by using any dredging procedure, near complete bottom rehabilitation will occur in one to two years.

Dredging for pier construction will cause temporary water turbidity. Mobile aquatic life will probably avoid the dredged area until the water clears. Water quality and level of aqautic life should return to normal within three months following dredging. A silt curtain will surround the dredging area until no longer considered necessary.

Dredging activity will be undertaken at a time when it will least interfere with migrating aquatic life and when the biota is least susceptible and the biomass is lowest.

Excess dredge material will be deposited behind appropriate water containment berms upland of the dredge site. There are no unique, fragile or ecologically valuable resources on the proposed disposal site.

Dredging will not have a significant adverse effect upon the environment or other adjacent or nearby uses and will not interfere with the public use of public shorelines. Design and appearance of the piers will be in contrast to but not incompatible with the design and appearance of surrounding uses. The proposed dredging is not contrary to the general intent of the Seattle Shoreline Master Program and is incidental to a water-dependent marine research use, which is a preferred use.

c. Riprapping

Riprap faces will be constructed to a stable slope and will be of clean rock (2-man rock). The riprap is necessary to check erosion and is required for a water-dependent use adjacent to a navigable channel.

d. Backfilling

Due to shoreline irregularities, some presently submerged areas will be isolated behind the proposed riprap. Dredged spoils and other backfill will be placed behind the riprap to support a uniform pier and staging area. The backfill is incidental to and required for the riprap. No other backfilling of submerged areas or wetlands will occur.

e. Piling

Piling is required for extension of the piers over water to adequately serve as moorage for NOAA scientific research vessels. Substantial littoral drift will not occur and no known historical or scenic values will be sacrificed as a result of piling. All pile driving operations will be carried out so as to minimize noise levels. As pilings will be of steel and/or concrete, no pollutants will be present to leach into the water.

f. Lagoon

Design and appearance of the lagoon will be compatible with and will enhance the design and appearance of surrounding uses and is consistent with the general intent of the Shoreline Master Program of the City of Seattle. Creation of the lagoon is incidental to a water-dependent marine research use. Adherence to applicable regulations is assured should the lagoon be used for aquaculture purposes at a future time. The lagoon will be designed to avoid potential for entrapment of juvenile salmonid.

g. Vessel Service Facilities

Routine maintenance of NOAA vessels will be undertaken pierside at the Sand Point site. All commercial cleaners used on NOAA vessels will be water soluble and of a non-toxic and biodegradable type. Most chemically inert paint chips and powder will be recovered before falling into lake Washington. Any material falling into the lake will be confined within an oil containment boom and removed.

Although fueling of NOAA ships will not occur at the Sand Point site, some handling of fuel will occur, generally not in excess of 30 gallons. All NOAA vessels will utilize an oil containment boom surrounding the vessel at waterline. Provisions for water, sanitary, ballast and bilge systems will be incorporated into the design of the piers.

APPENDIX H

VESSEL MAINTENANCE ACTIVITIES THAT WOULD OCCUR AT THE PROPOSED FACILITY

APPENDIX H

VESSEL MAINTENANCE ACTIVITIES THAT WOULD OCCUR
AT THE PROPOSED FACILITY*

TYPICAL REPAIRS, MODIFICATIONS, AND SERVICING WHICH WOULD BE ROUTINELY ACCOMPLISHED ON NOAA SHIPS AT THE NEW FACILITY INCLUDE:

1. Small structural repairs and modifications to topside areas, such as repairs of access openings and modification of winches and rigging. This type of work would utilize primarily the services of welders and shipfitters with assistance from other trades as necessary.

2. Interior modifications and repairs, such as galley equipment relocation, painting of quarters, and installation of scientific gear.

3. Mechanical repairs and modifications, such as motors, generators, and pumps (internal vessel repair).

4. Electronic repairs and modifications, such as radar, radio transceivers, antennas, etc.

5. Small boat repairs including haul-out to indoor shop area, repainting and minor mechanical repairs.

6. Minor repairs to forklift trucks and other job equipment in the Shops building.

7. Touch-up painting of topside structures and portions of the hull above the waterline. Most touch-up work would be accomplished with brush or roller. Spray activities would be minimal. The paint used is vinyl or alkyd based and non-poisonous. Painting below the waterline using an organo- or butyl-tin antifoulant would be conducted only at commercial shipyards.

8. Removal of old paint by scraping, sanding, or wire brushing. Since most paint work would be done on deck, old paint chips and powder from scraping or wire brushing is swept up and removed as solid waste. Sandblasting of the entire hull for repainting would be accomplished in commercial shipyards.

*Prepared by the NOAA Western Regional Center Project Office.

9. Application of commercial cleansers used to prepare metal surfaces for repainting. These cleansers are food-grade liquids which are highly water soluble, non-toxic and bio-degradable.

10. Use of rented mobile cranes to accomplish heavy lifing tasks in resupplying NOAA vessels. Permanent cranes would not be used. Equipment and supplies would be moved by trucks and battery-powered electric forklifts.

REPAIRS AND MODIFICATIONS WHICH WOULD NOT BE ACCOMPLISHED AT THE NOAA FACILITY INCLUDE:

1. Sandblasting and repainting entire topside structures of vessels.

2. Drydocking of vessels for repair, painting and modifications required under the waterline.

3. Major topside structure modifications, such as addition of deckhouse and major hull plating.

4. Small boat major overhauls or modifications.

5. Primary fueling of NOAA ships. Fueling is normally accomplished at either Point Wells or Manchester. Class V vessels may occasionally fuel at a commercial pier in Salmon Bay.

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